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TECHNOLOGY TRANSFER

HEARINGS

BEFORE THE

SUBCOMMITTEE ON
SCIENCE, RESEARCH AND TECHNOLOGY

OF THE

COMMITTEE ON
SCIENCE AND TECHNOLOGY
U.S. HOUSE OF REPRESENTATIVES

NINETY-NINTH CONGRESS

FIRST SESSION

MAY 21, 22, 1985

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*Ranking Republican Member.
**Serving on Committee on the Budget for 99th Congress.

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TECHNOLOGY TRANSFER

TUESDAY, MAY 21, 1985

HOUSE OF REPRESENTATIVES,
COMMITTEE ON SCIENCE AND TECHNOLOGY,
SUBCOMMITTEE ON SCIENCE, RESEARCH AND TECHNOLOGY,
Washington, DC.

The subcommittee met, pursuant to notice, at 9:30 a.m., in room 2325, Rayburn House Office Building, Hon. Doug Walgren (chairman of the subcommittee) presiding.

STATEMENT OF HON. DOUG WALGREN, A U.S. REPRESENTATIVE FROM THE COMMONWEALTH OF PENNSYLVANIA, AND CHAIRMAN, SUBCOMMITTEE ON SCIENCE, RESEARCH AND TECHNOLOGY

Mr. WALGREN. We are rapidly approaching the fifth anniversary of the enactment of the Stevenson-Wydler Technology Innovation Act of 1980. This law, as most know, was passed with very strong, if not complete, bipartisan support and was designed to address what was seen as a disturbing trend in technology development. The United States, then as now, was setting the pace in basic science, as shown by its share of Nobel Prizes and other indices of scientific excellence, but the most innovative commercial products were often coming from overseas, and some of these were based on American ideas.

It was the goal of the Stevenson-Wydler Act to reverse this trend by finding better ways to make ideas with commercial potential originating in Federal laboratories more readily available to those in the private sector with the capability and the incentive to exploit them. Stevenson-Wydler also looked for new ways to encourage cooperative technology development between the private sector, the universities, and the Government. And, of course, with the change in administrations, key provisions of the Stevenson-Wydler Act, including the Centers for Industrial Technology and the National Industrial Technology Board, were never implemented, and Federal agencies routinely waived other sections of the act.

The Office of Productivity Technology and Innovation, while giving some recognition to the goals of the Stevenson-Wydler Act, has taken its own approach. In this past year we have also been faced with proposals to abolish parts of the Department of Commerce and the National Science Foundation which have been charged with carrying out the mandates under the act.

Much has changed since 1980, but the basic problems addressed by Stevenson-Wydler are still with us. Our trade imbalance is extending to some areas of high technology as well, where we were

quite strong just 5 years ago. Technology transfer activities have partially shifted to State and local governments with the creation of numerous organizations to encourage high technology and development and to exploit the technological riches of local universities and local business and Government resources. But we have also been the beneficiary, since 1980, of important studies such as the White House Science Council's Federal Laboratory Review Panel.

It is not our intent in these hearings to pretend it is still 1980 in reauthorizing the Stevenson-Wydler Act, but we do intend to move ahead to the present problems, taking into consideration both the budget restraints that we operate under today and trying to assess the changes that have occurred since 1980, and encourage the redefinition of the Federal role in technology transfer.

We have before us today bills that have been introduced by Congressman Stan Lundine, who is with us this morning as our opening witness, and Congressman Michel, both of which deal with cooperative agreements, invention policy, and the transfer of technology from Federal laboratories. The development of each bill has involved a substantial amount of work and each contains ideas that are worth exploring. We welcome the comments that the witnesses that we have today may be able to provide on these bills.

We also would welcome constructive comment on what has happened to date under Stevenson-Wydler with suggestions for changes in that act that might increase the flow of American commercial products developed from innovative Government research. We welcome views on what has worked well in the technology application programs of particular agencies and whether these ideas can be extended to others, and we are certainly interested in creating a record that would include suggestions regarding other legislative changes and initiatives which we should take in our common good. We appreciate the time that goes into the preparation by the witnesses that we'll have and the perspectives that they might be able to give us.

Let me recognize the ranking minority member, Mr. Boehlert, for any opening comments he might have, and then turn to Mr. Lundine.

[The prepared statement of Mr. Walgren follows:]

OPENING REMARKS OF HON. DOUG WALGREN

We are rapidly approaching the fifth anniversary of enactment of the Stevenson-Wydler Technology Innovation Act of 1980. This law, which passed with strong bipartisan support, was designed to attack what was seen a as disturbing trend in technology development. The United States then as now was setting the pace in basic science as shown by its share of Nobel Prizes and other indices of scientific excellence. However, the most innovative commercial products were often coming from overseas and some of these were based on American ideas.

It was the goal of Stevenson-Wydler to reverse this trend by finding better ways to make ideas with commerical potential originating in the Federal laboratories more readily available to those in the private sector with the capability to exploit them. Stevenson-Wydler also looked for innovative ways to encourage cooperative technology development among the private sector, universities, and government. Of course, with the change in Administrations, key provisions of Stevenson-Wydler, including the Centers for Industrial Technology and the National Industrial Technology Board were never implemented. Federal agencies routinely waived other sections of the act.

The Office of Productivity, Technology, and Innovation, while paying lip service to the goals of Stevenson-Wydler, has done its own thing. This past year, we have also

been faced with proposals to abolish the very parts of the Department of Commerce and the National Science Foundation which have been charged with carrying out the Stevenson-Wydler mandate.

Much has changed since 1980, but the basic problems being addressed by Stevenson-Wydler still are with us today. Our trade imbalance is extending to some of the high technology areas which were the strength of our economy just five years ago. Technology transfer activities have partially has shifted to State and local governments with the creation of numerous organizations to encourage high technology development and to exploit the technological riches of local universities and government laboratories. We also have been the beneficiaries, since 1980, of important studies such as the report of the White House Science Council's Federal Laboratory Review Panel.

It is not our intent in these hearings to pretend it is still in 1980 by reauthorizing the Stevenson-Wydler Act. Rather, we intend to move ahead to the present, taking into consideration both today's budget constraints and the significant changes which have occurred since 1980, and to redefine the Federal role in technology transfer, accordingly.

We have before us today bills introduced by Congressman Lundine and Congressman Michel, dealing with cooperative agreements, invention policy, and transfer of technology from Federal laboratories. The Development of each bill has involved hard work and each contains worthwhile ideas to help the United States make better commercial use of these welisprings of scientific knowledge. We welcome constructive critiques of the two bills before us.

We welcome constructive criticism of what has happened to date under Stevenson-Wydler and suggestions for changes in that act to increase the flow of American commercial products developed from the innovative ideas of Government researchers. We welcome views on what has worked well in the technology applications programs of specific agencies an whether these ideas can be generalized. We are open to suggestions regarding other legislative changes and initiatives which will help the United States regain technology market share and close our trade gap.

I am confident that other worthwhile suggestions in the technology transfer and innovation areas will be put forward during these hearings and hopeful that we will then be able to fashion legislation which will help us meet our current problems head-on and regain our industrial preeminence during the 1980's and beyond.

STATEMENT OF HON. SHERWOOD L. BOEHLERT, A U.S REPRESENTATIVE FROM THE STATE OF NEW YORK

Mr. BOEHLERT. I'll be very brief, Mr. Chairman.

Your opening statement was comprehensive. The subject before us is extremely important, and we have a very impressive list of witnesses, starting with my distinguished colleague from the great State of New York, Mr. Lundine.

I look forward to this morning's hearing and the subsequent followthrough.

Mr. WALGREN. Thank you.

On behalf of the other members of the committee let me welcome you back, Stan, and let me say at the outset that you have been one who has given more attention and focus to this area of national policy than almost any other, and we appreciate your perspectives, particularly in that light.

Welcome to the committee, and please proceed.

STATEMENT OF HON. STAN LUNDINE, A U.S. REPRESENTATIVE FROM THE STATE OF NEW YORK

Mr. LUNDINE. Thank you very much, Mr. Chairman.

I have a prepared statement, and I would ask consent that the entire statement be made a part of the record.

Mr. WALGREN. Without objection.

Mr. LUNDINE. I seldom ask to testify before a committee on which I serve. This is the exception that proves the rule, because I

care very deeply about the issues of innovation and technology application that are raised by this important series of hearings.

Technological innovation is a positive force that can drive both economic growth and industrial productivity. It gives us new or improved commercial products and processes and creates jobs and income as new industries are born or existing industries expand.

Technological innovation is necessary to restore competitiveness in our basic industries. Let's take automobiles for an example. The use of advanced ceramic materials may reduce engine weight and engine cooling and lubrication requirements. New lightweight but high-strength materials, polymers, and fiber composites may reduce overall vehicle weight and improve fuel economy. Increased use of advanced computers will reduce the time required to design and test new body styling for increased aerodynamic efficiency. It will also allow robots to perform more complex manufacturing operations.

This sort of innovation is also needed to reverse the recent erosion of our competitive edge in high technology industries. The Nation's electronics sector, for example, amassed a $6.8 billion trade deficit in 1984. This is the first time that this traditionally healthy industry has ever ended the trade year in the red, and projections for 1985 are even worse.

The President's Commission on Industrial Competitiveness noted in its recent report that application of new technologies is one of the major ways in which the United States can become more competitive.

Much of that technology is available for utilization because it is produced or developed in our Federal laboratories. Therefore, the Commission on Industrial Competitiveness appointed by President Reagan recommended that the Federal Government manage its research and development with more concern for commercial application and competitiveness.

The Stevenson-Wydler Technology Innovation Act was an important first step in improving the utilization of Federal technology. I believe that the time is right for us to take another step, and have introduced legislation, as you noted, for this purpose with a number of my colleagues on a bipartisan basis.

H.R. 1572, The Federal Science and Technology Transfer Act, promotes more effective utilization of technology produced by the Federal laboratories. It allows these resources to be more readily shared with private companies wishing to develop new products, and also with local governments in need of technical solutions to their problems.

Federal scientists and engineers would be able to work side-by-side with their university or industry counterparts on projects that were co-funded by their institutions. I believe that research in the Federal laboratories can be better attuned to industrial needs without compromising the labs' missions, and the benefits that accrue to industry from the Federal share of the funding are also in the national interest. This is consistent with the recommendation of the 1983 Federal Laboratory Review Panel of the White House Science Council.

Extensive interpersonal interaction allowed by these cooperative arrangements is generally believed to be an extremely effective

method of technology transfer. In a recent study of NSF's University-Industry Cooperative Research Program, both industry and university participants lauded the benefits of working closer together and being able to view the work from each other's perspective. Many experienced profound and beneficial changes in their attitude toward science in general and in the way they approach their research, in particular.

I believe that scientists and engineers in the Federal laboratories would benefit similarly from cooperative arrangements proposed in this legislation. Under this act, cooperative R&D agreements would be subject to a few conditions. Nondomestic technology transfer is discouraged by requirements for participation only by U.S. entities, and for U.S. manufacture of resulting products. I feel that taxpayer-supported Federal technology should be used to stimulate new jobs and income at home, not abroad. Preference is also provided for small business.

To further promote technology transfer from the Federal laboratories, this bill institutionalizes the Federal Laboratory Consortium for Technology Transfer. The Consortium is currently an ad hoc organization of representatives from over 300 Federal laboratories, representing 11 Federal agencies. It has been the principal body, during the last decade, for networking between Federal laboratories and for facilitating technology transfer from the Federal sector. The effectiveness of the Federal Laboratory Consortium has been limited only by the resources available to it as an ad hoc organization. H.R. 1572 provides a modest level of funding that would greatly increase the level of technology transfer activities.

Institutionalization of the Federal Laboratory Consortium has also been recommended by the Joint Economic Committee of the Congress in a report that has just been made available. I commend my distinguished colleague from California, Dan Lungren, for conducting a series of invaluable hearings on entrepreneurship and innovation that led to this document. The report recommends that we "identify the Federal Laboratory Consortium as the primary coordinating agency for the promotion of technology transfer," and that we "provide a statutory basis for the Consortium."

Finally, H.R. 1572 proposes to encourage utilization of Federal technology through the distribution of patent royalties received by the Federal agencies. I believe that an appropriate use of these funds is to provide incentives, both to Government-owned laboratories and their Federal employees, for seeking commercialization of their new technologies.

In conclusion, Mr. Chairman, let me emphasize that the value of these hearings transcends the two legislative proposals that are already before us. We are seeking ways to improve the utilization of Federal technology because we have serious national problems that technological innovation can help us address. The legislation before us represents an initial proposal for accomplishing this, and it should therefore serve well as a starting point for our thoughts on this problem.

It would be unfortunate if our discussion, though, were to be limited to the specific provisions of this initial proposal. Therefore, I hope that the distinguished witnesses before you today and tomorrow will share their insights with us, offering their own ideas and

proposals for improving technological innovation in addition to commenting on the specific provisions of the legislation.

Thank you very much.

[The prepared statement of Mr. Lundine follows:]

STATEMENT OF HON. STAN LUNDINE

Mr. Chairman, I am pleased to appear before the Subcommittee today to testify on behalf of legislation designed to improve the utilization of Federal technology. I have a great interest in technological innovation which I follow both as a member of this subcommittee and as chairman of the House Task Force on Industrial Innovation and Productivity.

Technological innovation is a positive force that can drive both economic growth and industrial productivity. It gives us new or improved commercial products and processes, creating jobs and income as new industries are born and as existing industries expand. As an illustration, the commercialization of biotechnology has spawned a new, rapidly growing industry. Worldwide sales for this industry are projected to reach 100 billion dollars by the end of the century.

Technological innovation can help restore the competitiveness of our basic industries. In the automobile industry, for example, utilization of new technologies during the next 15 years is expected to improve both the product and the production process.

The use of advanced ceramics materials may reduce engine weight and engine cooling and lubrication requirements.

New light-weight but high-strength metals, polymers, and fiber composites may reduce overall vehicle weight and improve fuel economy.

Increased use of advanced computers will reduce the time required to design and test new body styling for increased aerodynamic efficiency. It will also allow robots to perform more complex manufacturing operations.

These and other advancements could further enhance competitiveness by reducing the price of the product. The automobile industry is only one example. If we maintain a technological edge over our competitors and if we utilize those new technologies, we can provide a competitive advantage for many of our basic industries.

In addition to helping our basic industries, we must reverse the recent erosion of our competitive edge in high-technology industries. The Nation's electronics sector amassed a 6.8 billion dollar trade deficit in 1984. This is the first time that this traditionally healthy industry has ever ended a year in the red, and projections for 1985 are worse. The electronics sector is not alone; the President's Commission on Industrial Competitiveness noted in its recent report that the United States has lost world market share in seven out of ten high-technology sectors.

Although foreign trade barriers and the strength of the dollar are contributing factors to this decline, business week recently stated that the basic problem is the failure of American high-technology companies to consistently translate new technology into competitive products. The President's Commission agreed and identified the creation and application of new technology as one of the four major ways in which the United States can become more competitive.

Much of the new technology that is available for utilization is produced in Federal laboratories. The Federal Government funds approximately half of this country's total research and development and much of this work is performed in government-owned laboratories. Therefore, the Commission on Industrial competitiveness recommended that the Federal Government manage its research and development with more concern for commercial application and competitiveness.

The Stevenson-Wydler Technology Innovation Act was an important first step for improving the utilization of Federal technology. I believe that the time is right for us to take another step and I have introduced legislation for this purpose with a number of my colleagues in a bipartisan fashion.

H.R. 1572, the Federal Science and Technology Transfer Act, promotes more effective utilization of the technology produced by federal laboratories. The scientific and engineering expertise, the technology base, and the facilities and equipment within these laboratories are valuable national resources. This legislation allows these resources to be more readily shared with private companies wishing to develop new products and with local governments in need of technical solutions to their problems.

To encourage technological innovation, H.R. 1572 enables government-operated Federal laboratories to enter into cooperative research and development agreements with non-Federal parties. Federal scientists and engineers would be able to work

side by side with their university or industrial counterparts on projects that were cofunded by their institutions. I believe that research in the Federal laboratories can be better attuned to industrial needs without compromising the laboratories' missions and that the benefits that accrue to industry from the Federal share of the funding are in the national interest. This is consistent with the recommendations of the 1983 Federal laboratory review panel of the White House Science Council.

The extensive interpersonal interaction allowed by these cooperative arrangements is generally believed to be an extremely effective method of technology transfer. In a recent study of NSF's industry/university cooperative research program, both industry and university participants lauded the benefits of working closely together and being able to view the work from each other's perspective. Many experienced profound and beneficial changes in their attitudes toward science in general and in the way they approached their research in particular. I believe that scientists and engineers in the Federal laboratories would benefit similarly from the cooperative arrangements proposed in this legislation.

Under this act, cooperative R&D agreements would be subject to a few conditions. Non-domestic technology transfer is discouraged by requirements for participation only by U.S. entities and for U.S. manufacture of resulting products. I feel that taxpayer-supported Federal technology should be used to stimulate new jobs and income at home, not abroad. Preference is also provided for small businesses.

To further promote technology transfer from the Federal laboratories, this bill institutionalizes the Federal Laboratory Consortium for Technology transfer. The Consortium is currently an ad hoc organization of representatives from over 300 Federal laboratories representing eleven Federal agencies. It has been the principal body during the last decade for networking between Federal laboratories for facilitating technology transfer from the Federal sector. The effectiveness of the Federal Laboratory Consortium has been limited only by the resources available to it as an ad hoc organization; H.R. 1572 provides a modest level of funding that would greatly increase the level of technology transfer activities.

Institutionalization of the Federal Laboratory Consortium has also been recommended by the Joint Economic Committee of the Congress in a report that has just been made available. I commend my distinguished colleague from California, Hon. Dan Lungren, for conducting the series for invaluable hearings on entrepreneurship and innovation that led to this document. The report recommends that we "identify the Federal Laboratory Consortium as the primary coordinating organization for the promotion of technology transfer" and that we "provide a statutory basis for the consortium."

Finally, H.R. 1572 proposes to encourage utilization of Federal technology through the distribution of patent royalties received by Federal agencies. I believe that an appropriate use of these funds is to provide incentives to both Government-operated laboratories and their Federal employees for seeking commercialization of their new technologies.

In concluding, Mr. Chairman, let me emphasize that the value of these hearings transcends the two legislative proposals that are already before us. We are seeking ways to improve utilization of Federal technology because we have serious national problems that technological innovation can help us address. The legislation before us represents an initial proposal for accomplishing this and it should therefore serve well as a starting point for our thoughts on this problem. It would be unfortunate if our discussion were to be limited to the specific provisions of an initial proposal, however. Therefore, I hope that the distinguished witnesses today and tomorrow will share their insights with us, offering their own ideas and proposals for improving technological innovation, in addition to commenting on the legislation before us.

Mr. WALGREN. Thank you very much, Congressman Lundine. That is good testimony and an interesting bill.

I wonder if you could comment on your instinct for any conflicts of interest that might arise, as I understand it, that are presently anticipated in the Criminal Code. Do you know? Can you tell me?

Mr. LUNDINE. Mr. Chairman, it is——

Mr. WALGREN. It is my understanding that the competing bills do waive parts of the Criminal Code, and yours would not. Can you give some sustenance to that?

Mr. LUNDINE. Yes. My bill, unlike H.R. 695, does not waive the Criminal Code's conflict of interest provisions for Federal employees. We must avoid even the appearance of inside deals if coopera-

tive agreements are going to thrive. I certainly would be open to the development of a special set of conflict of interest provisions if your review of this legislation points up any needs. But I think it would be a mistake to waive them entirely because I think that it would create a suspicion that there was some conflict of interest and hurt the overall effort.

Mr. WALGREN. Thank you, Mr. Lundine.

Mr. Boehlert.

Mr. BOEHLERT. I just would like to commend my colleague for his leadership in this area. Obviously, I think you've come up with a very good piece of legislation because my name appears after yours. [Laughter.]

I just want to thank you very much.

Mr. WALGREN. Well, thank you very much. We appreciate it, and we look forward to talking to you about it informally in the process as we go along.

Mr. LUNDINE. Thank you.

Mr. WALGREN. Let me ask the three witnesses on the next assembled group to come forward, if they're here. Dr. Sherwood Fawcett, Chairman of the Board of Trustees at Battelle Memorial Institute; Dr. John McTague, the Deputy Director for Science at the Office of Science and Technology Policy; and Dr. Bruce Merrifield, the Assistant Secretary for Productivity, Technology and Innovation.

We are glad you're all here, and I wanted to recognize Mr. Morrison for the purposes of an introduction, and then we will proceed with the panel. As I understand it, we'd like to start with Dr. McTague in terms of the formal presentation, and then turn to Dr. Fawcett, who has a conflict, and our sometimes-imposed on Dr. Merrifield at that point; but really, out of consideration of Dr. Fawcett's conflict, we would like to proceed in that order.

Mr. Morrison.

Mr. MORRISON. Mr. Chairman, perhaps I should wait until Dr. Fawcett testifies.

Mr. WALGREN. OK, if you have the time. I wanted to give you the opportunity to introduce him at whatever time you have for us.

Well, let's start, then, with Dr. McTague. Welcome to the committee. It's good to see you back so soon. Written statements will, of course, be made part of the full record automatically, and all of the witnesses should feel free to summarize and highlight the points that they feel really deserve to be underscored in whatever way they feel is best to communicate them.

So, Dr. McTague, welcome to the committee.

STATEMENT OF JOHN P. McTAGUE, DEPUTY DIRECTOR, OFFICE OF SCIENCE AND TECHNOLOGY POLICY

Dr. MCTAGUE. Thank you, Mr. Chairman.

I appreciate the opportunity to meet with you today to discuss the role of technology in industrial competitiveness. It is particularly appropriate that you are focusing on this issue at the same time that you are grappling with the intolerably large Federal deficit. As we make the hard choices necessary to get our fiscal house in order, it is important that we also lay the rest of the foundation for the future of our economic well-being.

The President's Commission on Industrial Competitiveness in its aptly-titled report, "Global Competition: The New Reality," succinctly stated the Government's role in building that foundation. One of the painful lessons this country has learned in recent years is just how adaptable we have to be in a world that is quickly changing. The rise of strong foreign competition for sales in the world market, and especially for sales in our previously insulated domestic market, means that U.S. industries no longer have the luxury of setting the pace at which new technologies are introduced. Others have been working faster than we have. One direct consequence can be seen in our increasingly negative balance of trade.

The trade situation has elevated the issue of industrial competitiveness in our national priorities and leads to the question of how well prepared we really are to compete under today's new conditions. We have been forced to take a fresh look at what our competitive advantages really are. As pointed out by the President's Commission on Industrial Competitiveness, our high costs of capital and labor require offsetting competitive advantages in two allied and increasingly important areas: our technology, and our talent. And that, in a nutshell, is a prime reason that science and technology have become such important parts of Government policy.

In the United States, Government and industry will invest some $110 billion in research and development this year. Obviously, if it were simply the total amount of money the Nation invests in research and development that determined its industrial competitiveness, the United States would be far ahead of everyone else because, at that level of $110 billion a year, we invest more than France, Japan, West Germany, and the United Kingdom combined. But obviously there is not a one-to-one correlation between national R&D investment and industrial competitiveness. We simply must get more competitive advantage out of the Federal Government's half of this large investment. In effect, we must get multiple payoffs from these Federal programs.

In the Federal Government, our response to this new reality has been to allocate very large increases in support of basic research, which grew by 55 percent over the past 4 years. At the same time, Government has been reducing its role in development of the kinds of technology that industry was far better qualified and motivated to do, such as commercially oriented energy technologies, like synthetic fuels. The result of this double shift in priorities has resulted in the clearest and most logical delineation of Government and industrial roles in support of R&D that we have seen for many years. Basic research, or the pursuit of frontier knowledge, is valued by society for many reasons, not the least of which is that the search for new knowledge satisfies a fundamental human curiosity. However, the Federal Government's focus on basic research stems from more concrete benefits that are returned to the society that pays for the research.

The first is the way that basic research, as opposed to direct development of technologies, can vastly multiply the base of scientific and technical knowledge. That knowledge, then, becomes the foun-

dation for modern industrial innovation, as well as for advances in areas like medicine and environmental quality.

As technological advance becomes ever more rapid, it becomes even more difficult to predict in detail. However, its link to advances in fundamental science become closer. So our investment in basic research becomes ever more relevant and an ever-increasing competitive edge.

The other major benefit we reap from investment in basic research, especially basic research in universities, is the stimulation and education of new talent. We realize that our continued national security, our continued industrial leadership, and our ability to remain competitive depend directly on the quality of that next generation of scientists and engineers. For example, the National Science Foundation's Engineering Research Centers are an excellent model of an effective cooperative research arrangement among Government, industry, and universities. These Centers, the first of which were announced a few weeks ago, will encourage universities to formulate an entirely new approach to engineering education involving industrial participation, and will stress the importance of creativity and multidisciplinary approaches to real problems.

The Engineering Research Center Program has been enthusiastically received by both industry and universities. There were over 140 proposals submitted to NSF in the first round, totalling over $2 billion in requests. I believe the Engineering Research Center Program is critically important to the country's future, and should be expanded to achieve the level of influence we need in the development of engineering education.

We are also currently exploring more effective means of technology transfer from our Federal laboratory system to private industry. The real key to technology transfer is on the bench level, in one-on-one interactions. In that spirit, we should try to encourage the mingling of the Government, university, and industrial cultures rather than create mechanistic structures and rigid formulas.

As recommended by the White House Science Council's Federal Laboratory Review Panel, increased discretionary funding in the DOE multiprogram laboratories, currently near the lowest for all Government laboratories, would offer the possibility to increase industrial interactions most appropriate to the local situations of the individual laboratories.

The President's Commission on Industrial Competitiveness concluded that there is an important need to elevate the priority for science and technology in Government to match its importance elsewhere, and to reflect the truly substantial national resources being devoted to it. I heartily agree. In that spirit, one small but highly symbolic contribution of the Stevenson-Wydler Act, namely, the National Technology Medal, deserves special notice and approbation.

In summary, the human material and institutional resources in our industries, universities, and Federal laboratories are of great potential advantage for the international industrial competition we are experiencing. Imaginative and flexible cooperative efforts among these three sectors will give us the leverage we need to maintain and increase our economic strength and national security.

Thank you, Mr. Chairman.

Mr. WALGREN. Thank you, Dr. McTague.

Let's then proceed to Dr. Fawcett, but I want to recognize Mr. Morrison, our colleague on the committee from the State of Washington. Welcome.

Mr. MORRISON. Thank you, Mr. Chairman and other members of the subcommittee. It's a pleasure to intercede in this important hearing to make an introduction, an introduction that I think is appropriate because I can think of no other research organization that is more ideal to kick off these technology transfer hearings that you are commencing, and I commend you for that.

Battelle Memorial Institute is famous around the world. They are pioneers in contract research; since 1935 they have been leaders in transfer of technology from the laboratory to the commercial sector. And if you picked a couple of examples of their developments that are important here on this campus, I would have to include typewriter correction fluid and the Xerox copy process, Mr. Chairman—vital to us.

Dr. Sherwood Fawcett is our special guest. He started with Battelle Institute a number of years ago, in 1950; he is part of the postwar generation of nuclear physicists. We love him in the Northwest because from 1964 to 1967 he organized Pacific Northwest Laboratories which, I believe, is the largest arm of Battelle, a Department of Energy multiprogram laboratory with 3,000 very, very fine people out in my district.

From 1968 to 1984 he served as the Chief Executive of Battelle Memorial Institute and is currently the Chairman of the Board as well. And, Mr. Chairman, I know that you're going to learn a great deal from this accomplished scientist and distinguished leader in the transfer of technology so vital to us.

Dr. Sherwood Fawcett.

Mr. WALGREN. Thank you very much, Congressman Morrison, and we appreciate your being a resource to the committee.

Dr. Fawcett, please proceed.

STATEMENT OF DR. SHERWOOD FAWCETT, CHAIRMAN, BOARD OF TRUSTEES, BATTELLE MEMORIAL INSTITUTE, COLUMBUS, OH

Dr. FAWCETT. Thank you, Congressman Morrison, for those very kind words.

Mr. Chairman and members of the Subcommittee on Science, Research and Technology, I greatly appreciate this invitation and opportunity to present my views on technology transfer issues.

The subject of technology transfer is of great interest to me and one I've struggled with directly for the past 17 years. It is, of course, a very broad subject and one that is highly important to our Nation; indeed, it is also a subject being actively discussed in almost every country in the free world.

Rather than comment directly on the proposed bills, I want to concentrate my remarks on some factors that I have found to be vital in the overall process of utilizing the results of technology for products or processes which benefit the public. These factors have to do with commercializing intellectual property. This process is what I call the second invention, and I'll tell you why in a minute.

To begin with, let's clear the air with a definition. In essence, what we are doing in our Federal laboratories and facilities is using the processes of scientific research and development to create or develop intellectual property. By intellectual property I mean any type of information, including patents and know-how, that can be used by the Government or by an industrial organization to help it do its job better or to produce a new product. This is the major way the public finally benefits from technology. In many cases, this intellectual property can be used by more than one Government agency, or by an industrial organization. In the latter case, this process is called commercialization. It is this process we are discussing today; that is, taking intellectual property which has been developed or invented for a governmental purpose and commercializing it with benefit to the public and profit to the industrial organization.

At this point I will talk about this process on the basis of our experience at Battelle Memorial Institute. In addition to performing research for companies, individually or in groups, and for various U.S. Government agencies, Battelle uses other means as well to develop and commercialize intellectual property. We have a subsidiary, known as the Battelle Development Corp. The function of this corporation is to develop inventions, either ones made by Battelle staff members or by outsiders, and then commercialize them by licensing to industry, by establishing new companies, or by other means.

The classic example of an invention made by an outside inventor, developed by the Battelle Development Corp. and later licensed, is xerography. When we first became aware of this invention the inventor was literally working in his kitchen, building up voltage in his crude copying machine by rubbing cat's fur on ebony. That is a far cry from the dry copiers that all of us know today.

Let me tell you a short, true story about the commercialization of xerography by the Xerox Corp. As I said, the actual invention of xerography was made by an independent, lone inventor, one Chester Carlson, who was unable to interest any company in picking up his idea until he made contact with the Battelle Development Corp. The story goes that there were some 12 companies that looked at this process of xerography at the time and turned it down. Battelle took Carlson's invention, added considerably to it in reducing it to practice, and then eventually licensed the process to the Haloid Corp., which is now the Xerox Corp. This is background to my story.

Several years ago I had occasion to meet one of the vice presidents of one of the 12 companies that considered the invention and turned it down. We got to talking about the xerography case, and he said to me, "As a matter of fact, I was on the evaluation team that looked at the process and turned it down. We considered the process and knew that it could be made to work, that Battelle would be able to develop it, and that it was a feasible idea from a technical standpoint. But we also knew that nobody would buy it; it would be too expensive. The thing we missed," he said, "was the way to commercialize it." And that's the second invention; it was almost as important as the first one, and it was made by the Haloid Corp. when it invented the concept of leasing or renting

copying machines and taking rental income in terms of a few cents a copy. He said, "That is what made the whole thing economically feasible."

Thus, we here today need to talk about the second invention. In order to talk realistically about the process of commercializing intellectual property, I want to explode some myths—or at least tell you that, in my experience, these old ideas are almost completely untrue. First, there is the one that "if you invent a better mousetrap, the world will beat a path to your door." I hope by the time I'm through you will realize, if you don't already, that the invention is only the starting point. Practically, nó one will take off and do all the things necessary to commercialize an invention just because it's good.

Then there's the myth that licensing an invention or other intellectual property is easy and automatic. This is a favorite belief—forgive me—of some Wall Street investment bankers, Government bureaucrats, and university professors. It's a real boobytrap.

And then there's the idea that the inventor or technical person involved knows best how to commercialize the technology. In fact, he or she generally knows the least about what is required in the total commercialization process.

Finally, there is the conventional wisdom that stand-alone patents are always valuable. Almost the opposite is true. One stand-alone patent can usually be invented around.

In general, the process of commercializing intellectual property is very complex, highly risky, takes a long time, costs much more than you think it will, and usually fails.

Now, let me tell you some positive facts of life in this business.

The area of technology transfer on which I would like to focus today has to do with the commercialization of totally new technical development; that is, I'm not talking about changing the hood ornaments or hub caps. We're talking about totally new development. That means a new market, as well as a new product in the new market. This type of development is the most important and the most difficult to commercialize. On the positive side, it means entirely new products for the consumer, new jobs, and new profit for the producer. In effect, it represents a whole new base of industry, including taxation, jobs, supporting structure, and so on for the region lucky enough to be hosting the new venture.

There are several major aspects to commercializing new developments of this type. First, we must recognize that the risks are very high; it takes a long time to get them to the market, and it is very expensive.

Concerning the risks, I'd like to give you a few statistics from the Battelle Development Corp's. first 48 years in this kind of business, and I believe it will make the point. We've checked the records, and during those 48 years we evaluated about 20,000 ideas. We invested in a total of 770, of which 105 have yielded some income through licensing, but only 41 of the inventions yielded a net income; that is, from 20,000 to 41 that really yielded a net income. So, you can see this attenuation rate—that is, the failure rate—is very great. Fortunately, our batting average is gradually improving.

Now, also we find that the time from invention to substantial income, when there is any, is about 12 years on the average. This experience is comparable to others. For example, nylon took 11 years from invention to first commercialization. Silicon took 39 years; penicillin, 16 years; the zipper, 27 years; the helicopter, 23 years; television, 22 years; and optical wave guide fibers, 16 years. For these reasons, investment in these entirely new high-risk situations has a different dimension from that of the ordinary investment decisions of normal business practices.

In addition to these factors, all of us should recognize that out of the total cost of marketing a new technological development, including R&D, preparation for manufacture, investing in manufacturing, marketing, and advertising, only about 10 percent is actually for R&D. Thus, any decisionmaker viewing a new invention or development has to consider how he finances the remaining 90 percent of the cost of commercialization and manages it through these startup phases.

Another fact of life in this business is what we at Battelle call the valley of death. Every new major project of which I am aware has had to pass through the valley of death. In general, every project looks its best at the time the decision is made to commit major funds in an effort to commercialize it. From there on, and for quite a while, the news is all bad. Technically, the project gets into trouble, such as scaling up to production. From a marketing viewpoint, it turns out that the market isn't as big as originally estimated, and many potential customers aren't as interested, and the competition is much more formidable than was anticipated. So, everything goes negative. This is the bottom of the valley of death. Anyone can prove to you, the decisionmaker, that the best thing to do is to cut your losses by getting out and shutting down. At this point only the fanatic, the person who has an unreasonable, illogical conviction that the project will go against all advice and logic, rides through the valley of death. He solves the problems and reaps the rewards.

I might parenthetically add that one of the most interesting examples of the valley of death is on the front page of the Washington Post today, the story of this SKIPPER weapons system and the troubles they had getting it going. A beautiful, interesting example of fanatics and everything else.

Thus, in the organization, during the commercialization there have to be one or more advocates or fanatics who really believe in the importance of the product. They must be backed up by top management that provides support, funding, and morale to the advocates. Without the advocates and the top support, the project will never make it through the valley of death.

The point here is to recognize that when you have a specific piece of intellectual property, who you license or otherwise engage to commercialize it is vital to its chances for success. You can't just assume that because you have given someone a license, the job is done and that the public will reap the benefit.

Now, back to the concept of the second invention. For each first invention, what are the requisites for the second invention? I believe they are these:

First, a comprehensive statement of all of the conceivable uses of the first invention.

Second, a detailed, realistic evaluation of the markets, including the design of a method of marketing the result of the first invention.

Third, a financial plan which allows for considerable flexibility—mostly, additional funds, if needed.

Fourth, the choice of an ideal vehicle to perform the commercialization; that is, a new company, licensing to an established company as a joint venture, and so forth.

Fifth, a time estimate and a time sequencing of the steps that need to be performed. And finally, a team of advocates, or at least one.

These, then, I think, are the elements necessary to commercialize a new invention or development.

I want to end this discussion on a positive note, for I believe that our ability to master these procedures is vital to our Nation's economic health and well-being. Furthermore, it is the final justification for the large expenditure our Nation has made and is making in the creation and development of new technology.

At the risk of being very presumptuous, let me tell you what I would do if I were responsible for getting public value out of a portfolio of intellectual property which was developed at Government expense in a Government laboratory. And I hasten to add that all of these comments are subject to the limitations that Government regulations, budgets, and political and bureaucratic elements will permit, and that's a very large proviso.

But first, I would get a technical evaluation by people knowledgeable in the field but outside the Government. I might add that there are plenty of good, competent consultants in practically every field. Then I would obtain from outside contractors a brainstorming study of all the ways the invention might be used in the commercial market. Market studies are the most attractive of these; a pro forma business plan to commercialize the intellectual property, either by a new, small company, a joint venture, or a large, established company. And, finally, a prospectus which combines all of these factors.

Then I would select a group of the most logical, promising companies that should be interested in this subject; and finally, I would present the prospectus to each of them, simultaneously, with the invitation to submit a commercialization plan of their own. The best one would be chosen to implement commercialization. What the company would get would be an exclusive—and I do mean exclusive—field of use license to use the intellectual property. In return, it would have to agree to certain "feet to the fire" performance conditions.

There are many variations to this scenario; these are simply the elements of the scheme. When you have done these things, you have made the second invention.

I submit that any proposed legislation should be evaluated on the basis of how well it will permit and encourage this process to happen.

I hope these comments are useful to the subcommittee. You have a very important task to perform.

Thank you.

[The prepared statement of Dr. Fawcett follows:]

STATEMENT OF DR. SHERWOOD L. FAWCETT

Mr. Chairman, members of the Subcommittee on Science, Research and Technology. I greatly appreciate the invitation and the opportunity to present my views on technology transfer issues, on how the results of Federally funded research and development can more effectively be brought to the American commercial marketplace, and on what improvements might be made in the Federal government's efforts to accelerate the rate of U.S. technological innovation.

The subject of technology transfer is of great interest to me, and one I have struggled with directly for the past 17 years. It is, of course, a very broad subject, and one that is highly important to our nation. Indeed, it is also a subject being actively discussed in almost every country in the free world.

Rather than comment directly on the proposed bills, I want to concentrate my remarks on some factors that I have found to be vital in the overall process of utilizing the results of technology for products or processes which benefit the public. These factors have to do with commercializing intellectual property. This process is what I call "The Second Invention", and I will tell you why in a minute.

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In order to talk realistically about the process of commercializing intellectual property, I want to explode some myths, or at least tell you that, in my experience, these old ideas are almost completely untrue.

First, there's the one that "If you invent a better mousetrap the world will beat a path to your door." I hope by the time I am through you will realize, if you don't already, that the invention is only the starting point. Practically no one will take off and do all the things necessary to commercialize an invention just because it's good.

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During those years, it evaluated about 20,000 ideas, invested in a total of 770 ideas, of which 105 have yielded some income through licensing, but only 41 of the inventions yielded a net income.

As you can see, the attenuation rate—that is the failure rate—is very great. Fortunately, our batting average is gradually improving. We find that the time from invention to substantial income—when there is any—is about 12 years, on the average. This experience is comparable to others. For example, nylon took 11 years from invention to first commercialization; silicons, 39 years; penicillin, 16 years; the zipper, 27 years; the helicopter, 23 years; television, 22 years; and optical waveguide fibers, 16 years.

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In addition to these factors, all of us should recognize that out of the total cost of marketing a new technological development—including R&D, preparation for manufacture, investing in manufacturing, marketing, and advertising—only about 10 percent is acutally for R&D. Thus, any decision maker viewing a new invention or development has to consider how he finances the remaining 90 percent of the cost of commercialization and manages it through the start-up phases.

Another fact of life in this business is what we at Battelle call the "Valley of Death". Every new, major project of which I am aware has had to pass through the valley of death. In general, every project looks its best at the time the decision is made to commit major funds and effort to commercialize it. From there on, and for quite a while, the news is all bad! Technically, the project has trouble, such as scaling up to production. From a marketing viewpoint, it turns out the market isn't as big as originally estimated, and many potential customers aren't as interested, and the competition is much more formidable than was anticipated. Everything goes negative.

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Thus, in the organization, during the commercialization, there has to be one or more advocates—"fanatics", who really believe in the importance of the product. They must be backed up by top management that provides support, funding, and morale to the advocates. Without the advocates, and the top support, the project will never make it through the valley of death.

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First, I would get a technical evaluation by people knowledgeable in the field, but outside the government. (There are plenty of very good, competent consultants in practically every field.)

Then, I would obtain from outside contractors: (a) A brainstorming study of all the ways the invention might be used in a commercial market; (b) market studies of the most attractive; (c) a pro forma business plan to commercialize the intellectual property either by a new small company, a joint venture, or a large established company; and (d) a prospectus which combined all of these factors.

Then, I would select a group of the most logical, promising, companies that should be interested in this subject.

And, finally, I would present the prospectus to each of them, simultaneously, with the invitation to submit a commercialization plan of their own.

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I hope these comments are useful to the Subcommittee. You have a very important task to perform. Thank you.

DR. SHERWOOD L. FAWCETT, A BIOGRAPHICAL SKETCH

Dr. Sherwood L. Fawcett is Chairman of the Board of Battelle Memorial Institute—an organization of 7,500 scientists, engineers, and supporting specialists engaged in worldwide research, educational and technology development activities. A pioneer in contract research, Battelle is the world's largest nonprofit, independent research institute.

From 1968 to 1984, Dr. Fawcett was also Battelle's chief executive, and, as such, spearheaded the Institute's entry into new areas of research and new working relationships with business, industry, education, and government that further the use of science to meet human needs. Active in national and international policy-making

groups, he is a frequent spokesman on science's role in dealing with complex social problems.

Dr. Fawcett has had managerial assignments both at the Institute's Columbus Laboratories and its Pacific Northwest Laboratories at Richland, Washington. He was manager of the Department of Metallurgy and Physics at Battelle-Columbus when he was selected in 1964 to establish the Pacific Northwest Laboratories. He served as Director of Battelle-Northwest until 1967, when he became executive Vice President of Battelle Memorial Institute. He assumed the presidency in 1968, and was elected to the Institute's Board of Trustees in 1969. In 1981 he became Chairman of the Board, as well as the Institute's Chief Excutive Officer.

A member of the postwar generation of nuclear physicists, Dr. Fawcett began his career at Battelle's Columbus Laboratories in 1950, participating in research directed toward the development of nuclear reactors for power and naval propulsion. Subsequently, he supervised programs to determine the performance and reliability of reactor fuel and structural components, directed evaluations of reactor concepts, and coordinated engineering and design studies of reactor cooling and moderating systems.

Dr. Fawcett is the author of some 50 technical articles and papers. He was formerly a vice president of the American Association for the Advancement of Science and chairman of the Association's Section on Industrial Science. He is Immediate Past President of The American Society For Macro-Engineering, a Director of The Atlantic Council of the United States, and Battelle's representative to The Atlantic Institute for International Affairs (Paris).

Other affiliations include the Atomic Industrial Forum, the American Nuclear Society, the American Physical Society, the American Society for Metals, the Metallurgical Society of AIME, the Ohio Society of Professional Engineers, Sigma Pi Sigma (physics), Sigma Xi (science), Tau Beta Pi (engineering), the Newcomen Society, and Delta Chi social fraternity.

A civic leader, he is Past President and a member of the Board of Trustees of Children's Hospital in Columbia, a former Director of the Ohio Chamber of Commerce, Past Chairman of the Board of Trustees of the Columbus Area Chamber of Commerce, and a Trustee of the Columbus Museum of Art.

Dr. Fawcett is a Director of The Columbus Gas System, Inc., a Trustee of Case Western Reserve University, and a member of the Board of Overseers of Whitman College.

He earned his B.S. degree in engineering physics from The Ohio State University and his M.S. and Ph.D. degrees in physics from Case Institute of Technology. In addition, he holds an Honorary Doctor of Science degree from The Ohio State University, an Honorary Doctor of Public Service degree from The Detroit Institute of Technology, an Honorary Doctor of Laws degree from Otterbein College, an Honorary Doctor of Science degree from Whitman College, an Honorary Doctor of Laws degree from Gonzaga University, and an Honorary Doctor of Humane Letters from Ohio Dominican College.

Other honors conferred on Dr. Fawcett include the American Society for Metals' Medal for the Advancement of Research, the Case-Western Reserve Achievement Award, and the Preston Davis Award, presented by Citizens Research, Inc. for outstanding civic contributions to enrich the Columbus community.

Mr. WALGREN. Thank you very much, Dr. Fawcett. There is a sharp whiff of reality there for us, and we do appreciate it. Very interesting testimony.

Let me turn to Dr. Merrifield, and invite you to present. As many of you know, Dr. Merrifield is the Assistant Secretary for Productivity, Technology and Innovation with the Department of Commerce, and has been a real contributor to public discussion of these issues over the last several years. So welcome to the committee, Dr. Merrifield. We understand that you are accompanied by Norman Latker; is that correct?

Welcome to the committee, and you may proceed.

STATEMENT OF DR. D. BRUCE MERRIFIELD, ASSISTANT SECRETARY FOR PRODUCTIVITY, TECHNOLOGY AND INNOVATION, U.S. DEPARTMENT OF COMMERCE

Dr. MERRIFIELD. Thank you. I'd like to suggest that my written comments be entered in the record.

Mr. WALGREN. Without objection, and that will be the case for all such submissions.

Dr. MERRIFIELD. I would like to comment briefly on section XI of the Stevenson-Wydler Act, which directs Government agencies to establish Research and Technology Application Offices, which they have done. In support of this, President Reagan has explicitly endorsed the recommendation S-2 of the White House Science Council Federal Laboratory Review Panel, the Packard report, and this report specifically recommends that formalized authority be granted to Government laboratories to enter into cooperative research projects with industry, with universities, and with nonprofit organizations, and also that the authority of Government-operated laboratories be extended to grant patent rights to private sector organizations in order to encourage external cooperation in Federal lab research.

The Packard report noted that technology transfer from Government labs to industry has been impeded by substantive legal and policy issues lying outside laboratory jurisdiction and control, such as Government patent policy and the details of enabling legislation. The combination of these impediments and lack of incentives has resulted in the fact that very little of the approximately $15 billion of annually Federally-funded technology in these labs has ever been licensed for commercial development; in fact, only about 4 percent of 28,000 Government patents have ever been licensed.

Part of the reason for this, of course, is that there has been no clear authority—as recommended by the Packard report—for decentralization of the management of the technology to the labs, where the technical competence to identify, useful technology does exist. Instead, the technology has basically been warehoused here in Washington with patent functions that have neither the detailed technical awareness nor much of the understanding of commercial potential that Dr. Fawcett has just outlined.

Needless to say, we are very much in support of the thrust of this legislation as recommended by the Packard report. In fact, Commerce participated in the development of the review panel's report, and therefore strongly supports their recommendations and implementation.

With that, I'd be happy to answer any questions.

[The prepared statement of Dr. Merrifield follows:]

TESTIMONY OF DR. D. BRUCE MERRIFIELD

Mr. Chairman, I appreciate this opportunity to discuss the Stevenson-Wydler Technology Innovation Act of 1980 and the activities of the Office of Productivity, Technology, and Innovation.

The ability of American industry to compete, both at home and abroad, is essential to achieving an increased standard of living, more and better jobs, and national security. The economic recovery has been beyond our expectations, but the issue now is substaining this recovery for the long-term in a drastically changed world trading environment. Over 70 percent of the goods manufactured in this country face competition from products made abroad, increasingly from Japan and other Pa-

cific Rim nations. Technology is accelerating, progressively obsoleting products and processes in shorter time periods. Mature industries are under pressure to reduce costs significantly and improve productivity and quality. At the same time, an explosion of entrepreneurial activity has been generating new business opportunities and jobs in the United States.

The challenge is to create an appropriate policy environment to enhance the innovative processes of the private sector to increase our competitiveness.

Technology transfer is a major factor in achieving competitive advantage because it can: Reduce costs; improve performance of existing products; create new products and businesses; help revolutionize mature industries; foster innovation that has a multiplier effect in terms of economic growth, jobs, and exports.

The major objectives of the Office of Productivity, Technology, and Innovation (OPTI) are to remove barriers and create incentives for the technology innovation process, to catalyze private sector self-help arrangements such as cooperative R&D and provide strategic information for use by the private sector to improve productivity growth and competitiveness in domestic and international markets.

The Administration now believes that the tasks the Office of Productivity, Technology, and Innovation were created to perform have largely been completed. Many of the concepts and incentives we pioneered have become commonplace private sector activities. We are considering the options for placing some of the functions of the Office elsewhere in the Department, but decisions have not yet been made. We are aware of the Department's important responsibilities for technology and productivity policy, and will ensure that they continue to receive attention within the Department.

The Administration appreciates that Congress may want to express its priorities in the technology area in legislation. Specifically with respect to Stevenson-Wydler, the Administration is opposed to an extension of the authorization of appropriations since it has been shown that the objectives of the Act can be achieved without direct Federal funding.

The Secretary of Commerce submitted a report to the President and Congress in February 1984 that summarized what had been accomplished during the first two years under the Act. I am enclosing a copy of the Report with this statement. The most important question I would like to discuss involves activities carried out under Section II.

Section II directs the agencies to establish Research and Technology Application Offices (ORTAs) in larger laboratories. These organizations have now been established and analysis of information provided by the agencies has led to an important conclusion.

Four types of technology transfer activities are carried out by Federal laboratories:

1. Information—which includes advice, technical assistance, reports, and other forms of aid, usually provided at minimal or no cost.

2. Personnel exchange—which includes guest workers at the laboratories and laboratory employees working at other locations.

3. Facility sharing—use of laboratory facilities by others for their own purposes, usually on a reimbursable basis. Laboratories may assist in performing the work or operating special equipment, but often do not have an interest in the results.

4. Intellectual property—which includes patents, copyrights, technical data, rights to future inventions, and other forms of technology that can be identified, owned and protected, and then licensed, assigned, or used. The intellectual property may have resulted from prior laboratory work, or may result from work to be done in the future.

Federal laboratories predominately use the first three types of technology transfer, and have been less involved in intellectual property transfers or what we call technology management. Yet, opportunities to help create competitive products, new industries and substantial employment can be generated from appropriate management and development of intellectual property. This is because the innovation process, which runs from identification of a need to marketing a product that meets that need, is usually very costly when new technologies are involved. However, without control of access to the new technology, there is a high risk that capital invested in the innovation will not be recovered and become profitable before others, who do not have to replicate the original development investment, copy the product and become competitors. The most significant opportunity for improving the transfer of technology generated by Federal laboratories to the economy and the competitive position of the United States lies in the area of improving intellectual property management.

The White House Science Council Federal Laboratory Review Panel recommended more collaboration between Federal laboratories and industry. But for industry to provide resources, it must be able to recover its investment through commercial use of the results, and this requires some changes in how the Government manages its intellectual property.

The Government laboratories are quite similar to research universities, and much of the university experience in owning and managing Government funded inventions under P.L. 96-517 is directly applicable to the laboratories. As universities began to market their Federally funded inventions, they often found that business was willing to fund additional work to continue development of those inventions or to branch out into related areas. As a result, university/industry collaboration has been increasing at an unprecedented rate. The United States has become the world leader in biotechnology, in part, because the universities that developed and patented the fundamental gene splicing techniques under Federal funding were allowed to manage and promote their discoveries. We have become increasingly convinced that inventing organizations, if they are given adequate authorities and incentives, are more motivated and can better achieve practical use of the technologies they create than are agency headquarters or centralized licensing operations. We understand that Congressman Michel has introduced H.R. 695 which would accomplish these purposes. These comments represent my views only, since the Administration has not yet formulated their position on H.R. 695.

Congress took a significant step toward this objective under P.L. 98-620, which allows most nonprofit organizations that operate Government-owned laboratories to own and manage their inventions. This was an additional step in applying the principles of decentralized management of inventions. We believe the time has come to apply the same principles to the Government-operated laboratories.

We believe that Federal agencies should be allowed to delegate to their laboratories the decentralized authority the laboratories need to manage their technology and enter into a wide range of collaborative agreements. Some intermediate level of management authority may have to be provided for the smallest laboratories, but the authority normally should be as close to the operating/inventing level as possible. The record of less than 4 percent of all Federal inventions licensed does not support continued control of inventions by agency headquarters staffs. Decentralized management envisions the handling of an ever expanding number of technologies. The actions the laboratories take under these authorities should be subject to minimal review, and certainly, Commerce should not have any review responsibilities except when policy issues are involved. Because of the wide range of laboratory missions, we believe that Government-wide regulations are not advisable at this time. Agencies should be able to develop their own implementing regulations or guidelines. Interagency teams working with a lead agency can develop models, agreements, and techniques that can be of use to individual laboratories.

We believe that monetary incentives, in the form of clearly established amounts or shared royalties for inventors and the laboratories, are vital to the success of any program to increase the transfer of inventions from the Federal laboratories to the private sector. We know, from the Commerce patent licensing experience and the university experience, that such incentives are important. Private industry has all sorts of methods it can use to reward their most productive people, but Government is extremely limited in this important area.

One example of effective collaboration helps illustrate the point. The Los Alamos National Laboratory recently announced a patent license agreement with a small firm to develop and market a laboratory invented device to identify bacteria and viruses in blood. Over $4 million was obtained from a research and development limited partnership to fund further development at Los Alamos. This collaboration is expected to advance the mission research of the laboratory, produce a major breakthrough in low-cost medical diagnosis as a by-product, and lead to a new product for export. It would not have been possible had the Department of Energy not waived its rights to the basic invention and follow-on developments to Los Alamos. The President alluded to this development in his State of The Union Message. Our objective is to make this type of collaboration benefiting both the Government and the public, as common an occurrence for Federal laboratories as it has become for universities. This focus on the process of innovation does not require appropriations under the Stevenson-Wydler Act.

I would now like to mention some of our other activities that support the intent of the Stevenson-Wydler Act. That law was designed to stimulate productivity, technology, and innovation in the private sector for the purpose of regaining or maintaining U.S. technical and industrial leadership in global markets. The Administration strategy has focused on the multifaceted process of innovation itself rather than se-

lected end-products of the process. Weak points in the innovation process have been identified, options for remedial action have been analyzed, and a number of initiatives have been undertaken. These initiatives can be categorized as removing barriers to innovation, providing incentives for private initiatives, and increasing awareness of strategic opportunities in noninterventionist ways. For the most part, this has involved specific use or modification of Government antitrust, patent, procurement, regulatory, R&D, and tax policies.

Examples of initiatives that have been taken include the following:

The R&D Limited Partnership (RDLP) concept has been advocated as a new method of financing innovation that is equally available and useful both to declining and growth industries. It minimizes direct Government intervention in the private sector. This approach is designed to achieve the objectives of Stevenson-Wydler, but to a much greater degree and over a much broader spectrum of industries than originally envisioned.

The transfer of Federally funded technology to the private sector is being pursued through Federal patent policy changes that "automatically" transfer Government-funded technology to the organizations that develop it and that have the incentive to commercialize it, rather than continuing the past process of "warehousing" and licensing it by Government at a later time.

Private sector cooperative R&D has been promoted through the removal of antitrust barriers to precompetitive arrangements by the passage of the National Cooperative Research Act of 1984.

Federal research funding is being reallocated toward basic research, where commercial incentives are weak or do not exist, and away from development and demonstration of commercial technologies, which are more appropriately undertaken with private funding.

Basic research performers are being encouraged to be involved in shepherding their new ideas farther along the private sector innovation process toward commercialization.

Protection of intellectual property held by developers of new technologies is being increased and ambiguities in current laws are being clarified.

Assistance has been provided on the innovation process to state and local Governments and to small business.

Finally, OPTI has pioneered the development of new strategic analytic tools and data bases that firms or industries can use to assess their relative performance and formulate new competitive strategies.

Within this improved environment, the Administration's Stevenson-Wydler initiatives have led to results such as the following:

Creation of new roles and organizational structures to intensify the development and utilization of university, nonprofit, and Federal laboratory results.

A sharp increase in patenting and licensing of technology by universities. Further, the Department's Center for the Utilization of Federal Technology has increased its rate of licensing of Federally owned inventions from 10 licenses issued in FY 1980 to 36 licenses in 1984. The Licensing Program has become self-sustaining, and the FY 84 licensees pledged a total investment of $86 million in R&D and facilities construction.

An upsurge in private sector activity in R&D limited partnerships, estimated at more than $2 billion over the last three years.

Issuance of a Presidential Memorandum on patent policy extending contractor ownership of Federally funded inventions to all R&D performers to the degree permitted by law.

A dramatic increase in state and local Government economic development initiatives, often in cooperation with universities and small business resources, aimed at nurturing the creation of new high technology firms and at the application of new technology to existing companies.

The articulation of a major new concept of shared flexible manufacturing facilities that would allow one plant to serve the manufacturing needs of different businesses much as shared computer facilities serve multiple information needs.

In conclusion, the steps being taken by both the public and private sectors are beginning to define a unique American response to the competitive challenge we face. Some of our traditional approaches are simply not going to do the job. The good news is we are moving forward—focusing on productivity, innovation, quality and competitiveness, without intervention by the Government in business decisionmaking.

The U.S. is well positioned to take advantage of its unique advantages. We have the most advanced basic research capability and technology in the world, an incomparable entrepreneurial spirit, the largest product market in the world, a dynamic

capital market, and an abundant supply of human resources capable of learning and applying the skills. I am convinced that with sufficient vision and resolve we can provide public policies which will enable the private sector to meet the new global challenges successfully. The key to this success is a dynamic process of innovation and its application.

Mr. Chairman, this concludes my prepared remarks.

Mr. WALGREN. Thank you very much, Dr. Merrifield.

Well, let's turn to some discussion with the panel as a whole. In general, we think of an increasing amount being spent in research and development by the Government, and Dr. McTague indicated that we're now spending something in the range of $110 billion. And yet, Dr. McTague also outlined that our present reality seems to be getting bleaker rather than less bleak if you use the measure of whether 7 out of the 10 high-technology areas are increasing their trade balance or decreasing their trade balance, or contribution to the trade balance.

It is also true that during this period of time we've had a substantial increase in the amount of moneys going to defense, and some would argue that the defense-related research is less dynamic in its commercialization potential. I don't know that that's true; on the other hand, in 1980 we were spending 54 percent of our Federal research budget on defense-related research and development. And now we are proposing to spend something like 72 percent. So 4 years later, even though we've seen a great increase in the amount spent, we've also seen a much larger increase in defense-related work.

Do any of the panelists have any views on whether that increase in defense-related commitment by the Federal Government is at all related to the contemporaneous decline and worsening of the export balance measure that we make of these industries? Dr. McTague?

Dr. MCTAGUE. First, it's perhaps worth looking at the separate contributions of research and development, of defense and nondefense. At the same time that defense R&D has increased in the Federal Government, it is also true that nondefense R&D has increased—in particular, basic research. The time constant for having an effect on any of the problems that we're talking about is long, but can be substantial.

With respect to the defense expenditures, it should be noted that in the Defense Department what's called R&D, research and development, is no longer what you and I think of as just R&D. Approximately 13 or 14 years ago, the early testing phases of new systems were included in the R&D budgets as opposed to the operations budgets, this being done from the point of view of quality assurance before a product is accepted. So the lion's share of R&D in the Defense Department is certainly not "R;" it is a combination of development, testing, and evaluation of very large systems.

We have seen, because of the necessity for buildup of our defense systems back to what they were in the 1960's, a rapid increase in system testing and systems about to go into operation. This increase is scheduled to begin to plateau in the coming years.

The other question is—let's take a look at the "R" and what the nondefense part of the country would call "D." What is the impact of the defense R&D on the Nation's competitive position? I think

that there is no question that, in the past, many of the most important of our technologies received massive spurts, and in some cases invention, because of defense needs. Essentially, the whole field of computers, up until the mid-50's, was developed in response to defense needs and often with very significant defense support. The field of microelectronics, of semiconductors. More recently, the field of superconductors; and presently, there is a massive effort in the Defense Department to change the way computers work and how they will interact with manufacturing processes through their efforts in the area of artificial intelligence. There is also a significant effort going on in terms of manufacturability of composites, for example, and in the area of the use of robotics. I suspect that these things will have, as in the past, very substantial impact on industrial competitiveness.

But let's not fool ourselves. The main purpose of the defense R&D budget is to do the R&D on the products that the Defense Department must consume. No one else has the incentive to do this R&D, so I think it's highly appropriate for them to be aiming in the direction that they are.

Mr. WALGREN. May I ask for other comments that you would like to make, Dr. Fawcett?

Dr. FAWCETT. Well, I think that I can only comment that, in my experience and I believe in Battelle's experience, the defense work has had a very important impact on new developments and new technology. I think the thing that happens is the time scale that we lose sight of. You do something right now, and it makes a difference.

One process that I personally was involved in was a process known as a "hip" process. That's a hot isostatic pressing. That was invented by a couple of guys at Battelle in 1952, developing fuel elements for the *Sea Wolf* submarine's nuclear reactor, and the process then was taken by Battelle's people and broadened out and applied. And it has taken almost 30 years before you see it as a significant, commercialized type of product, where people take material and can by hot isostatic pressing make new and different types of materials, and some things you can't do in any other way. Well, that's a 30-year time period, and yet it was started by a need that was identified in the Nuclear Submarine Program many years ago. I think the same thing will be seen happening in the future; but, as I tried to point out in my testimony, the problem is getting industry to see the new ways and to see how it might be used, and to help bridge that over. In my opinion we're not suffering so much from the quality and the amount of new developments and new innovations. I think our people are just as inventive as they ever were, but I think the problem we have is how to bridge this over, to get companies to invest and move forward with it when the time scale is so long. And more and more, companies are thinking in terms of the next quarter's profits and so forth, compared to a 12-year timespan. We have a mismatch there.

Mr. WALGREN. So you sort of feel that the difficulties are really on the pickup side rather than the transfer side, per se, that the transfer is relatively evident or the easy part of it, but as your testimony focused, the difficult part is the commitment?

Dr. FAWCETT. I think the commitment, and also visualizing how new products might come out of a certain process. The invention itself—I might add that at one time—I was not involved in it—but in the case of xerography, when they were going through the "valley of death," at one time the only thing they could think of was making it into a toy because it wouldn't work as a copier, and that was in the middle of trying to develop it. So there were all different kinds of ideas of what could be done to make money off of this thing, and I think the same thing may be true of other kinds of developments that start out as a need, identified, say, in the military or for some other Government application, but it's required then to think about, "How might you use this? What are the new types of things that would be useful products for consumers or the public?"

Mr. WALGREN. If the panel had the same foresight as Haloid and had conceived of the potential of that way of doing business, would Battelle have licensed that product to someone else?

Dr. FAWCETT. Well, as it turned out, we had entered into an agreement with the inventor to help him develop this, so we had a 50-50 split with the inventor. And then we licensed it to Haloid Corp. and they carried on the development and commercialized it.

Mr. WALGREN. I see. OK. I wondered whether that was something that, in hindsight, you would rather have kept in the organization.

Dr. FAWCETT. We did that right, I think.

Mr. WALGREN. Dr. Merrifield.

Dr. MERRIFIELD. I think our loss of competitiveness in the recent time has not been so much related to military mission work as opposed to R&D for commercial purposes so much as other forces that are operating, mainly the targeting strategies that other nations have initiated, the emergence of lesser-developed countries taking advantage of their cheap labor and cheap natural resources, the fact that technology is a world-wide phenomenon now, and everybody is in the act. It's a globally competitive situation, and the need is to remove the barriers now to the transfer of technology and to provide the incentives to make that happen more expeditiously.

One of the great barriers, of course, is the cost of capital. R&D is a form of capital investment and has to be amortized over the life of the thing it produces. It's the only form of capital investment, basically, that we've had very limited incentives for. When you add high risk to the high cost of capital, it's no wonder that many of our industries have been doing minor modifications of existing technologies instead of next-generation breakthrough stuff that's going to take 7 to 10 to 20 years to develop. And yet, it's going to be essential if we're going to remain competitive in these global markets.

So the cost of capital is a very serious impediment. More than that, when we talk now about Government-funded laboratory work, the impediments there have been the ambiguities and the regulations and laws that prevent the licensing of that technology on an exclusive basis to provide the incentives for industry to pick up nondevelopments and make the rather considerable investments that have to be made. Technology that comes out of a Government

laboratory is usually very far from anything that's commercial. It takes many years and many, many more dollars than have already been expended to push those things into commercial use.

Therefore, it is important to remove the barriers to expeditious licensing of that technology, and that has to be done at the local level where people know what the technology is and can work out these business plans with industry that are necessary if we're going to make those things commercial. Other barriers—the cost of capital being one of the significant ones—also must be removed if we're going to really mobilize and utilize that tremendous resource base that we have there. And it's extraordinary. I think NASA has identified several thousand potential products that have commercial value, but still are in need of identifying an industrial capability to develop them.

This is, I'm sure, just a fraction of the total pool of opportunities that exist there. That's what we're really trying to do—get the barriers out of the way and provide the incentives. And if we can do that, we can outrun anybody, anyplace, anytime. We have the advanced technology, and there's no excuse, really, for any of our industries to have lost the leading edge if we had been able to get some of these barriers out of the way and provide those incentives.

Mr. WALGREN. Mr. Boehlert.

Mr. BOEHLERT. Just one observation. I think there's a danger in drawing the assumption that all DOD R&D is automatically directed toward World War III. I don't share that view. I'm not willing to write a blank check for the Pentagon for every request that it has, but I think—I know—that a lot of very good work has come out of DARPA, for example, and some of the other DOD-related activities. So I'm not one that would draw that conclusion, that it's all negative. I think there are a lot of pluses for it, just as I can see, as we're proceeding in the area of the Strategic Defense Initiative, I can see a lot of potential commercial applications for the civilian sector.

Dr. Fawcett, let me ask you. Is Battelle Development Corp.—is that a for-profit corporation?

Dr. FAWCETT. No, sir. It's a nonprofit corporation, as is Battelle, the parent.

Mr. BOEHLERT. I was just wondering. You listed the 20,000 ideas that eventually resulted in 41 inventions which yielded a net income. Bottom line—what's the bottom line on that? I mean, all the expenditure involved for evaluating these 20,000 ideas, getting it down to the 41? Are you still on the plus side of the ledger?

Dr. FAWCETT. Yes, we are, but I hasten to add that you do it on just a few. Let me give you an example, the Xerox phenomenon, for Battelle. At the time that the Xerox Corp. was beginning to lease out these machines, to get started on that program they needed a lot of cash. And so, paying us royalties—they would like to get rid of that burden. So we renegotiated our agreement. Instead of a license, we sold the patents to them. And the other part of that, in selling the patents—this goes back into the 1950's, the 1950's——

Mr. BOEHLERT. I hope they gave you some stock.

Dr. FAWCETT. Yes, sir; we took stock in the company. It turned, out, as I have pointed out, that that decision—if we had sold the

stock that day, the decision would have been a $44-million decision. In essence, we sold the patents for $44 million, roughly.

But then, the board of trustees at Battelle had the wisdom to hang onto that stock, and that was a $275-million decision—two different decisions—so it's very hard to look at it and say, "What was this worth to Battelle?" It depends on which way you want to play it. But either way, our overall net so far is ahead of the game. But you don't make a lot of money on every one of these things. We call them spikes; every once in a while you hit one, and then you get a payoff like 1,000 to 1. But most of them are duds, and a few of them make a little bit of money. It's the nature of that kind of a business.

Mr. BOEHLERT. Dr. Merrifield.

Dr. MERRIFIELD. Well, can I comment on this? I think that the true measure of the value of that investment was not what the return was to Battelle, but look at Xerox and the tens of thousands of jobs they've created and the tremendous tax revenues that they've paid and so forth that have subsequently resulted. It's an incredible new industry worldwide. And so it's a multiple of anything that has ever returned to Battelle. Battelle has been the catalyst that is self-sustaining and, hopefully, growing so that they can continue to do this incredibly positive work. But the real benefit is to society in the other things that it generates. And that's a very outstanding example.

Mr. BOEHLERT. Let me ask all three panelists, and perhaps, Dr. McTague, you would be first to comment since you haven't commented on this question yet.

There's an idea floating around this town, and it has been for a couple of years now, about establishing a separate cabinet-level Department of Science and Technology, and I kind of find it has a lot of sex appeal to me. What do you think, in pluses and minuses? Could I ask the three of you?

Dr. MCTAGUE. The real issue there is not so much do we want or would we profit from a new bureaucratic structure. The real question is, what can we do to raise the level of priority of science and technology in Government to where it is in society as a whole and to where it should be in order to maximize both economic and other societal benefits from this great scientific and technical resource that we have.

I find it a great anomaly that in this Government which depends so heavily on science and technology, and this society which depends so heavily on science and technology, the Government side of it—there is only one line officer who has overview over our scientific and technological enterprises, and that's the President of the United States. There's no one at the cabinet level who speaks to the broad range of problems that relate to science and technology, who has a view of how what is going on in his agency is related to what goes on in another agency, how these programs should be coordinated, how we should get maximum return, both in the economic sense and in the Government needs sense for our massive $55 billion investment in research and development.

I think that the largest payoff from having someone at high level speaking to these issues and with line authority is the raising of the consciousness, more than it is the bureaucratic reshuffling.

There could be downsides; certainly, as you centralize more of these activities you also centralize the possibility for making mistakes, and you don't have the advantage—well, a mistake made over here, there might be something positive over there.

Having someone having rigid control over all R&D in the Government, I think, would be a mistake—for example, the Defense Department, which has its own very particular needs—and removing all R&D from various agencies would be a mistake, because local incentive is important. But there are many areas of generic research which were historically spread in a curious variety of agencies. High-energy physics, which truly is one of the most basic of all basic researches, is in the Department of Energy, not in the National Science Foundation.

So, I think the main point is more one of a cultural level and of a level of making sure that there is a spokesman at the highest governmental forum, making sure that we do get our maximum return on our R&D dollar.

Mr. BOEHLERT. Dr. Fawcett.

Dr. FAWCETT. I'm no expert on the organization of Government, but it seems to me that you can look somewhat to how industry organizes its R&D. This is the old question for a big company, do you have a centralized R&D department or do you have them farmed out as small groups in different divisions of operation? And I guess, to me, it's a matter of, What are you doing the R&D for? Really, you're trying to solve a problem. You're trying to do something. You're trying to create something, usually, for the Government; that's why it's presumably funding the work. And those things, then, need to be—it seems to me the organization needs to be close in to the mission, close in to the other part of the organization that has the need. You can then look at some general things. You can look at fundamental research, for example, where you're just trying to get new knowledge or lead to some general things, and that could very easily be centralized. And then, I think if you look at some of the large corporations, you will find that pretty much their centralized laboratories are more general; but then, they never give up the specific laboratories in the different operating divisions. So, I think you could draw a parallel there, which I think is pretty much along the same lines that Dr. McTague is talking about.

Mr. BOEHLERT. Dr. Merrifield, do you have any comment?

Dr. MERRIFIELD. No.

Mr. BOEHLERT. One last question, Mr. Chairman, if I may. I don't have any pride of authorship, and if somebody else is doing something better than we are, then I say let's follow their lead.

What are they doing, for example, in Japan that we aren't doing? Or in Western Europe that we aren't doing, that we might emulate? I have a feeling—let me add to that—that we are as inventive, if not more inventive, than any other people in the world because we have a unique character in our people. We've got an amalgam of all of them. But we have such serious problems, and it was brought to mind by a minor incident just recently, to me, when a company in my district manufactures baseball bats but can't export them to Japan, where baseball is the national game, because they don't meet Japanese safety standards. So, we have all

sorts of barriers all around the world to our innovativeness when we want to export it.

What are they doing better? MITI, for example, in Japan—do they get involved in the commercialization, the second invention phase? Dr. Merrifield?

Dr. MERRIFIELD. Well, I think the targeted industry strategy has been effective in many ways. It also has some major fallacies. The strategy, basically, is to target the industry, pull the players together, throw out the little ones, concentrate the business on the whole market. That's the first step.

The next step is to parcel out R&D among the remaining players, sometimes with or without subsidy from MITI, so you don't do any redundant work. And you share that.

The third step is to leverage the results 80 or 90 percent with 4 or 5 percent capital.

The next step is to close off imports into the home market to maximize the economies of scale there.

Then, because you have the captive home market, now you can two-tier price, put all your costs into the first 8-hour shift for the home market; the next two are for export at 15 or 20 percent less. We have some great confidential data on this.

Then you manipulate the exchange rate, and then with export subsidies you export to the United States way below any of our costs. You know, 100 percent, virtually, of the consumer electronics business, VCR's and so forth, 95 percent of the motorcycle business, some 90 percent now of the 256K memory chip business—they've recently lowered their price to less than $4 a chip on that, on the 256K; that's way below our cost. The 64K chip is selling for $0.70 a chip now, and on a learning curve, that cost ought to be about $2. So, you know, not even an IBM can stand up to a whole nation that targets its industry and mobilizes these various forms of Government-industry collaboration.

On the other hand, it's a destructive zero sum game that's destroying industries, and in fact, the Japanese are in trouble as a result. They may have the best steel technology in the world, but they're also operating at maybe 65 percent of capacity and losing money on every ton they're making.

The false assumption is that you're the only guy targeting, and when everybody else copies you, the result is that capacity in the industry is overbuilt. We now have 50 percent overcapacity worldwide in steel. And then all those undeveloped countries subsidize to hold the jobs and price the product below its true cost, and you destroy the industry for everybody.

The Japanese are operating way below break even on steel. They're operating maybe 45 percent of capacity in aluminum, 50 percent in commodity petrochemicals, textiles, shipbuilding, and so forth. They are losing money on every one of those. It's all borrowed money, and they're in trouble. And it's a zero sum destructive game that really should be abandoned.

The European Airbus people have copied this strategy. It could destroy the civil aircraft business, which is one of our most important industries in this country.

Mr. BOEHLERT. Well, that argues very eloquently against an industrial policy for the United States.

Dr. MERRIFIELD. Well, that's right.

Mr. BOEHLERT. Is that a fair interpretation?

Dr. MERRIFIELD. What I'm saying is, no bureaucracy is smart enough to target anything, and the Japanese are a living, breathing model. But the point is that targeting is happening, and this strategy is being copied more and more, and it impacts our industries. The Japanese are currently building up in semiconductors now; in a couple of years they'll have more than the world capacity needs, just in Japan alone.

Mr. WALGREN. Would the gentleman yield?

Mr. BOEHLERT. By all means.

Mr. WALGREN. The idea of being a zero sum game that is destructive—what's the sequence of destruction? When you say the French may destroy our aircraft industry, does ours go before theirs goes?

Dr. MERRIFIELD. Well, it could. And, for example, here's the way it works. The Airbus Industrie has taken about 15 or 20 percent of the wide-body jet market, with the A300 and the A310. Airbus ran a $4-billion negative cash-flow to do so. They are only halfway to break-even. They'll never make it; there aren't that many aircraft to be sold. Yet, they've already targeted a 150-passenger next-generation jet that will run them another $3 billion negative cash-flow. It will take them 950 aircraft, over 20 years at $25 million a copy, to break even. The total market is maybe 1,200, and if Boeing and Airbus are both in that industry, neither one of them could break even. And that destroys the industry. And, you know, that's not a very smart thing to do for anybody. And, of course, that's what we have to understand and abandon. Instead, we can collaborate to expand the global economy because we have unparalleled opportunities to do so now. The explosion of new technology is so vast that there's no need for us to go nose-to-nose in these commodity areas and destroy the industry when we can expand the economy and raise the quality of life of everyone. And that's really the shift in understanding that we have to have.

Mr. WALGREN. Well, I certainly agree that if we could live in the best of all possible worlds, we should; but I also think that we have to be careful that we protect our own before we go down the chute together.

The Chair would like to recognize Mr. Henry.

Mr. HENRY. Thank you, Mr. Chairman.

I'd just like to get back to a basic question, if I could, and that deals with the whole barriers to the transfer of technology. I was intrigued by Dr. Fawcett's comment that the problem was not so much the transfer of technology as the inventive nature of the pickup. And then Dr. Merrifield talked about the creation of incentives for pickup, and also, then, the capital problem relative to pickup. The capital problems can be just as imposing on the pickup side as they can be on the technological innovation side.

These bills, basically, both of them—and most of our discussion—has focused on how we transfer the technology out to make it eligible to be picked up, and particularly, flowing from the Government to the private sector, privatization in some ways, and dispersement and utilization with appropriate protections.

Have there been any discussions in terms of going the other way? What happens when I, as a private firm or research facility,

have a uniquely inventive concept and want to go to the Government, perhaps, and do it the other way and go to them for pickup? I've come from this on a much lesser scale at the State level, in Michigan, where we've been dealing with the same thing with our State University systems. And, of course, other States are doing exactly the same thing, in trying to align research park projects where business would actually approach the universities for contracted fundamental research or even, perhaps, on the other side, contract with applied research.

This gets us in a completely different kind of socioeconomic organization than we're used to thinking, perhaps more along the European or even more along the Japanese model in some of these, because you're almost getting a linkage, and the ties there are somewhat different. But I'm wondering, Dr. Fawcett, if you would comment--are there instances in which, for example, the sector, the private sector, might have its own proprietary research which it may wish to take to a Government lab for review for possible development? Are there ways in which we ought to be trying to facilitate the pickup? Can the Government labs take a place in pickup? I'm not convinced that the line between so-called fundamental research and applied research is as broad as we often make it out to be, conceptually. I think some of your comments on xerography were kind of illustrative of that. I'm not sure that the people who finally figured out how to use it commercially were any less inventive than the people who dreamed up the technology.

Dr. FAWCETT. Well, I guess I'm not quite sure how I would see this reverse taking place except the cases where the Government can use the product, in which case, then, the usual things happen. The industry worries about whether they're going to give something away where they may have a proprietary position that they've invented, that they've spent quite a bit of money and invested in. But in order to do business with the Government they'd have to sign over all the rights, and that's something to be looked at because they just simply won't do it. And we've had cases where we would be maybe talking to a Government agency about something, where we want to see it developed further, but the big question is, can you maintain your position? Can you maintain rights if you end up taking Government money or seeing the Government go on with the development? And that's something that could be of concern.

You mentioned the Japanese thing. I want to make a comment. We at Battelle Memorial Institute do a lot of contract research for the Japanese industry, and we see the Japanese a little bit differently. Most companies sell to them, or they try to do some business. But when you work for somebody you have a different view of him because you see how he thinks and how he works, how he makes his decisions. We have done some looking at this. So, I think that as we see it—not talking necessarily about MITI, but when you're talking about how a Japanese organization makes its decisions, our concept and their own concept themselves—they are not really inventive. They are the most beautiful, sophisticated copiers you ever want to see; but, basically, they are not as inventive as us crazy, mixed-up Americans. Or, as they say, "You're just trans-

planted Western Europeans." But that mind is much more inventive than the Japanese. I'm using the words that they've given me.

So, they are very anxious to take our inventions because they know that they don't create them as well, but they do know they can reduce them and get them down into practice and get them into industry. And how do they do it?

Well, many times, I think that it's the time scale again. They are prepared—they work on a 10- to 15-year time scale. One company that we do a lot of work with, that represents us in Japan, is the Mitsubishi Corp. They are now making most of their money on LNG, but they invested in LNG and the development of that whole system 10 to 15 years ago, and they lost a lot of money. But now it's paying off. And so they tell us, "This is natural." Now they're going to work on something that is going to pay off in another 10 or 15 years——

Mr. HENRY. Well, why did they invest in it 15 years ago and we didn't?

Dr. FAWCETT. Well, they needed to because, at that particular time, they recognized the energy potential, the energy shortage, and so forth. So they had a real need for it. But I guess what I'm getting at is that 10 years is not a long time for them to look. If you talk to the average American industry about something, they are looking at a time scale of——

Mr. BOEHLERT. Retroactively. [Laughter.]

Dr. FAWCETT. Yes; so if there is anything that could be done, I think, with American industry that could, either by some of these tax credits and so on—maybe one way to go at it—but anything that will enable American industry to take a longer term view, to be able to ride through the time it takes to bring some of these things along. That, to me, is a significant difference, just the way in which they are able to look at them.

There are other things, too, like their consensus decisionmaking which works both for them and against them. In one case, we had an invention; we took it to American industry, and nobody would touch it. We finally interested a Japanese company and they began the development of it. It was flexible—something in the computer business; I can't think of it right now—at any rate, in the course of the development, once they decided to go forward with it, twice we went to them and recommended that they kill the program even though it was to our disadvantage, because we said that the technical problems were too tough; we didn't think they could solve them; we thought it was a mistake to go ahead. Their consensus at that time was that there would have been great loss of face if they had killed the project, so they said, "No, go ahead." And we kept going, and we finally solved the problems. In that case, their consensus agreement—it takes a long time to get to the decision, but once they get there they are very loathe to change it. That helps them in some cases. In other cases, Americans have much more flexibility in our thinking. But if we could somehow get this time scale in order I think we would do a lot better in our commercialization process.

Mr. HENRY. I'll try Dr. Merrifield, because I maybe didn't get the question clearly.

In the States, the effort right now is trying to get the States to come up with really rather massive venture capital funds to help large businesses, medium-size businesses, smaller businesses to exploit the fundamental knowledge that they already have. Michigan has just come up with a massive one; I guess Connecticut was the first State. Half a dozen States have moved very aggressively on this. It is politically harder because we haven't gotten to the point of thinking that way. But, my goodness, if we subsidize urban renewal with UDAG grants and subsidize all kinds of other industrial developments with industrial development bonds, the next step is then to go this way, to subsidize and assist in some leverage fashion which aggressively promotes the application by creating economic incentives and rewards for doing so.

So, I want to get back to that side of the question, particularly since it was your comment that suggested that the pickup is much harder than the transfer.

Dr. MERRIFIELD. Well, that's a good point, and we're working very actively with many States and localities to develop these incubation centers around, flexible manufacturing core production facilities that will serve a whole group of entrepreneurs and make a whole bunch of different products but have the economies of scale running flat out.

And, of course, part of the objective is to develop these incubators around Government laboratories and universities. We're using the R&D Ltd. partnership as a partial method of funding. It's the only mechanism we've found so far that mitigates to some degree that cost of capital.

Collaborative efforts are critical because they distribute risk, pool resources, and multiply, potentially, the market downstream. So these are very active programs.

And by the way, this legislation would allow Government laboratories to collaborate directly with companies in developing industrial-initiated technology—a good idea doesn't care who has it—and still allow the companies to retain the patent rights.

Mr. HENRY. That's what I was getting at. It's a two-way thing.

Dr. MERRIFIELD. The law does provide that. The legislation does provide that, and that's an important aspect in our opinion.

Mr. HENRY. Is there any way we can get beyond these Federal research centers, the major research universities? Is there anything in Commerce in this area which seeks to take any computer modeling relative to different standard metropolitan statistical areas? Do you have any geniuses packed away somewhere that are just kind of play-modeling and figuring out how some of these breakthroughs can go into different manufacturing sectors, and different pieces are coming together and going out to communities and saying, "Hey, wake up, look what's there for you to do locally" in terms of some cooperative effort, given the nature of the manufacturing and service base? Or do we have to still rely on local chambers of commerce and boosterism?

Dr. MERRIFIELD. That's a good question, and thank you for asking it. We have, indeed—we've developed what we call a constraint analysis that gets 8 or 9 out of 10 successes instead of 1 out of 10 or 20. We are using this also in our binational research and development arrangements, which we are developing all over the world.

The first one was with Israel, and they've had something like 43 out of 46 successes in the last 4 years. I've just come back from India, and we're consummating a similar arrangement with India, we are also working with maybe 20 or 25 other countries around the world.

But this is exactly the model that we can use here in the United States as well——

Mr. HENRY. We're providing this for overseas countries and not for our own communities? Is that what's happening?

Dr. MERRIFIELD. Well, it's a joint thing. It's a 50–50 joint venture. These are arrangements between U.S. companies and foreign nation companies, which multiply the market potential. It's a win-win thing for us as well, and it expands our export trade and market penetration in countries where trade barriers would otherwise prevent us from operating. So, it's a very sound concept. But more than that, we can use that here; and in our collaborative arrangements we are putting together large consortia now around technology assessments we've done in most of the major industries, in advanced ceramics, in biogenetics, in flexible manufacturing, and so forth. This is one of the mechanisms. The computer simulation techniques that identify strategic factors are also part of this. What we've set up is an intern program in Commerce to bring key people from the Government laboratories and from the small business development centers into Washington here. We get them up to speed in the constraint analysis, the simulation techniques, and then we plant them back out in their laboratories or local sites so that they can screen more effectively the opportunities that are presented to them.

Mr. HENRY. Thank you.

Mr. WALGREN. Thank you, Mr. Henry.

Well, on behalf of the committee let me thank you all for the effort that you made to make these presentations this morning, being here. We appreciate your——

Mr. BOEHLERT. Mr. Chairman, just one last question, if you would yield?

As you know, tax policy is a very important issue in this town today, and there are some who are attacking the R&D tax credit. I would assume, from what you are saying—and assumptions are dangerous in this business—that you all would like that R&D tax credit retained. Do I hear any——

Dr. MERRIFIELD. That is the administration's position. [Laughter.]

Mr. BOEHLERT. Thank you, Dr. Merrifield. I wanted to give you that opportunity to put that in the record.

Mr. WALGREN. Who is attacking that R&D tax credit, anyway? [Laughter.]

Thank you very much, gentlemen.

Let me call the next panel, along with Congressman Michel, who has joined us, and we'll start off with Congressman Michel, but if he could be joined by Dr. Nam Suh, the assistant director for engineering at the National Science Foundation; Paul Houck, the information coordinator of the Pennsylvania Technical Assistance Program; Richard Neumiller, a former mayor of Peoria, IL, and Director of Legislative and Public Affairs for an organization that goes by the initials CILCO; and the Honorable Winfield Moses, the

mayor of Fort Wayne, IN, representing the U.S. Conference of Mayors.

We are particularly pleased that Congressman Michel can join us. As many know, Congressman Michel has developed legislation in this area, and I know that he both wants to talk about that and has some friends on the panel as well. So welcome to the committee.

As we said at the outset, written statements will be included in the record, and you all may feel free to summarize or outline or underscore the points which you feel are most important and in the way that you feel most effective to make.

Let's start with Congressman Michel. Welcome.

STATEMENT OF HON. ROBERT H. MICHEL, A U.S. REPRESENTATIVE FROM THE STATE OF ILLINOIS

Mr. MICHEL. Well, thank you, Mr. Chairman, and members of this subcommittee. May I personally express my thanks and appreciation for your holding this hearing on H.R. 695 and for offering me the opportunity to testify on behalf of the bill. And following my remarks, I'd like to introduce several individuals from the Peoria area who have been kind enough to come down here in order to indicate the importance of this bill to the economic development of our area.

This measure, H.R. 695, the Federal Laboratory Technology Utilization Act, is identical to S. 65, a bill that was introduced in the Senate by the distinguished majority leader, Bob Dole. The bill is designed to increase research cooperation between Federal laboratories and private entities, and would help clear the way for the greater commercial use of the ideas and the inventions resulting from such research.

At present, we have some 380 Federal laboratories in such diverse fields as health, space, energy, agriculture, and defense. They spend upwards of $17 billion a year, and employ one-sixth of the Nation's research workers. Yet, despite this major effort, the National Governor's Association concludes in a recent report that "these national laboratories are far from having begun to realize their full potential as catalysts for close industry-university research cooperation or as collaborators in joint university-industry research."

I guess one of my pet peeves over the years is that we tend to fund so much in the way of research at the Federal level which seemingly just ends upon some shelf gathering dust. I can recall, as a member of the Appropriations Subcommittee, asking the question time and again,"What has resulted from your research and what uses are we putting it to?" We frequently received rather elaborate answers to the first part of that question, but relatively little in the way of response when it came to practical application.

And I guess there's another related problem. Much of this research which is not being used domestically is, in fact, being used abroad. Foreign countries have access to research that is not patented or licensed for use in this country, and many foreign governments, particularly the Japanese, have utilized such research to develop products which they in turn import back into the United

States to compete against our own products. And that's simply a ridiculous situation. It's time we take steps to turn it around.

In the 96th Congress, we passed a measure, Public Law 96-517, which eased the patent and licensing requirements with respect to federally funded research in universities. The result has been an increased collaboration between universities and industry at an unprecedented rate. When universities have undertaken to market their federally funded inventions, they frequently find that industry is willing to provide additional funding to further development of such inventions or to branch out into related areas.

The Deputy Assistant Secretary of Commerce for Productivity, Technology, and Innovation testified before the Senate earlier this month that inventory organizations, if given adequate authorities or incentives, are more motivated and can better achieve practical use of the technologies they create than are agency headquarters or central licensing operations.

There is no reason, it seems to me, why we should have a different standard for federaliy funded research in universities than we do research in Federal laboratories. Both are similar in nature and both ought to be treated basically the same. That's what H.R. 695 seeks to accomplish.

The Federal Laboratory Review Panel of the White House Science Council has recommended greater collaboration between Federal laboratories and industry; but if industry is to become involved and provide resources and capital, it must be able to protect its investment through patent and licensing rights. Without this protection, such investment and ultimate commercialization of a research product will not take place.

I became particularly aware of this problem, and undertook the introduction of this bill as a result of a collaborative effort that is being undertaken in my hometown of Peoria. The Peoria Economic Development Council is presently organizing an Agriculture Research and Development Consortium which would pull together a number of corporations involved in agriculture research, along with the Department of Agriculture Regional Research Laboratory in Peoria and several universities, for the purpose of undertaking combined research endeavors. It is also expected that venture capital will be provided to turn the research findings into usable commercial products.

To enable this effort to succeed, however, we need the reforms and incentives provided in the legislation

In a nutshell, here's what it does. It authorizes agencies to permit their laboratories to enter into cooperative research and development arrangements with private entities. This includes accepting funds or services from, or providing services to, collaborating parties.

Two, it provides legal authority to laboratories to grant collaborating parties the rights to inventions made during such arrangements, and authorizes an agency to allow its laboratories to negotiate patent licenses.

Three, it provides creativity incentives to Government employees by allowing an employee whose invention is patented and licensed to receive at least 15 percent of the resulting royalties.

Fourth, it seeks to encourage Government employees to obtain commercialization of their inventions by providing that such activities will not be considered a violation of conflict-of-interest laws, and by allowing the employees to retain title to their inventions if the agency chooses not to patent the invention.

And, five, it assigns to the Secretary of Commerce the responsibility for assisting the agencies in implementing the provisions of the bill.

I understand that the subcommittee also has under consideration today H.R. 1572, a bill introduced by the gentleman from New York, Mr. Lundine, which is similar to H.R. 695. I commend the gentleman for the thrust of his bill and would simply like to point out two concerns, however.

No. 1, it contains a substantial number of conditions which may serve to frustrate the move toward collaborative agreements, and second, it doesn't provide incentives to commercialize inventions produced solely within the laboratories themselves. I think it's important that we ease the way as much as possible for cooperation of existing and future inventions, and so I believe H.R 695 represents the most effective vehicle for accomplishing this objective. I would hope the subcommittee will see fit to grant approval.

I should mention, before closing, that the Illinois House of Representatives in our State legislature has approved a bill introduced by Representative Don Saltsman of Peoria which provides $50 million in low-interest bond funds for agriculture research and development. This indicates the importance which the entire State of Illinois places on cooperative research endeavors. And for this State program to become effective, Congress must enact legislation along the lines that we've testified to here today in H.R. 695.

I once again want to thank the subcommittee for its consideration and for this opportunity to testify on behalf of the bill.

[The prepared statement of Mr. Michel follows:]

TESTIMONY OF ROBERT H. MICHEL, HOUSE REPUBLICAN LEADER

Mr. Chairman, let me at the outset express thanks to the subcommittee for holding this hearing on H.R. 695, and for offering me this opportunity to testify on behalf of the bill. Following my remarks, I will be introducing several individuals from the Peoria area who have been kind enough to come down here in order to indicate the importance of this bill to the economic development of our area.

H.R. 695, the Federal Laboratory Technology Utilization Act, is identical to S. 65, a bill introduced in the Senate by the majority leader.

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Yet, despite this major effort, the National Governors' Association concludes in a recent report that "these national laboratories are far from having begun to realize their full potential as catalysts for close industry-university research cooperation or as collaborators in joint university/industry research."

I guess one of my pet peeves over the years is that we tend to fund so much in the way of research at the Federal level which seemingly just ends up on some shelf gathering dust. I can recall as a member of the Appropriations Committee asking the question time and again: "What has resulted from your research and what uses are we putting it to?" We frequently received rather elaborate answers to the first part of that question, but relatively little in the way of response when it came to practical application.

There is another related problem. Much of this research which is not being used domestically is in fact being used abroad. Foreign countries have access to research that is not patented or licensed for use in this country, and many foreign governments particularly the Japanese, have utilized such research to develop products which they in turn import back into the United States to compete against our own products. That is simply a ridiculous situation, and it's time we take steps to turn it around.

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There is no reason why we should have a different standard for federally funded research in universities than we do research in Federal laboratories. Both are similar in nature and both ought to be treated basically the same. That's what H.R. 695 seeks to accomplish.

The Federal Laboratory Review Panel of the White House Science Council has recommended greater collaboration between Federal laboratories and industry. But if industry is to become involved and provide resources and capital, it must be able to protect its investment through patent and licensing rights. Without this protection, such investment and ultimate commercialization of a research product will not take place.

I became particularly aware of this problem, and undertook the introduction of this bill as a result of a collaborative effort that is being undertaken in my hometown of Peoria.

The Peoria Economic Development Council is presently organizing an agriculture research and development consortium which would pull together a number of corporations involved in agriculture research along with the Department of Agriculture Regional Research Laboratory in Peoria and several universities for the purpose of undertaking combined research endeavors. It is also expected that venture capital will be provided to turn the research findings into usable commercial products.

To enable this effort to succeed, however, we need the reforms and incentives provided in H.R. 695.

In a nutshell, H.R. 695 does the following:

(1) It authorizes agencies to permit their laboratories to enter into cooperative research and development arrangements with private entities. This includes accepting funds or services from, or provide services to, collaborating parties.

(2) It provides legal authority to laboratories to grant collaborating parties the rights to inventions made during such arrangements, and authorizes an agency to allow its laboratories to negotiate patent licenses.

(3) It provides creativity incentives to government employees by allowing an employee whose invention is patented and licensed to receive at least 15% of the resulting royalties.

(4) It seeks to encourage government employees to obtain commercialization of their inventions by providing that such activities will be not considered a violation of conflict of interest laws and by allowing the employees to retain title to their inventions if the agency chooses not to patent the invention.

(5) It assigns to the Secretary of Commerce responsibility for assisting the agencies in implementing the provisions of the bill.

I understand that the subcommittee also has under consideration today H.R. 1572, a bill introduced by the gentleman from New York (Mr. Lundine) which is similar to H.R. 695. I commend the gentleman for the thrust of his bill and would simply like to point out two concerns:

(1) It contains a substantial number of conditions which may serve to frustrate the move toward collaborative agreements; and

(2) It doesn't provide incentives to commercialize inventions produced solely within the laboratories themselves.

I think it is important that we ease the way as much as possible for cooperation of existing and future inventions. I believe H.R. 695 represents the most effective vehi-

cle for accomplishing this objective, and I would hope the subcommittee will see fit to grant approval.

I should mention, before closing, that the Illinois House of Representatives has approved a bill introduced by Representative Don Saltsman of Peoria which provided $50 million in low interest bond funds for agriculture research and development. This indicates the importance which the entire State of Illinois places on cooperative research endeavors. For this State program to become effective, Congress must enact legislation along the lines of H.R. 695.

I once again thank the subcommittee for its consideration and for this opportunity to testify on behalf of the bill.

Mr. MICHEL. If I might at this time, I'd like to introduce the two colleagues who have come along with me. To my immediate right, C. Richard "Dick" Neumiller, my good friend for many, many years; just gave up the rings as mayor of the city of Peoria, probably thankfully so, to devote more full time to his real chosen profession in the power business as director of legislative and public affairs for CILCO.

And then, next to him, Del Schneider, vice president of Central Illinois Light Co. For the past year he's been on special assignment to work with the Peoria Economic Development Council and has been specifically involved in developing the consortium of corporations, universities, and the agricultural research lab for the purpose of undertaking agriculture-related research and ultimately turning it into a usable commercial product.

So, if it is the subcommittee's desire, I'd like to yield to my colleague, or whatever, obviously.

Mr. WALGREN. Well, thank you very much for both the testimony and the introductions.

I would like to proceed now with Dr. Suh from the National Science Foundation——

Mr. MICHEL. Fine.

Mr. WALGREN [continuing]. And go through the witnesses in the order that we called them. I think that it might make some sense for the continuity of the record. But we appreciate very much both the comments on the bill and your interesting these gentlemen to come and be a resource for our process here at Washington.

Mr. MICHEL. Thank you, Mr. Chairman.

Mr. BOEHLERT. May I just interject here? I'd like to thank the leader for his excellent statement and for his leadership in this field. I know what a demanding schedule you have—are you able to stay with us for a while?

Mr. MICHEL. Well, we'll see how it goes. I'll stay as long as I can. And, obviously, I know, having been on that side of the table, that one ought to be prepared to respond to questions if his testimony hasn't been all that complete. And I realize—I would say just very quickly that I realize it's a very ticklish kind of subject matter, because having had to deal with it from that side of the table, knowing what our obligations are there, protecting the public interest and the Government's position—but I'll tell you, in a kind of a fit of frustration after, as I said, those 24 years on there and not getting all those answers I wanted to come forth from this side of the table simply because of some walls we had arbitrarily established, and failing to think beyond what we could accomplish and, I guess—what is it?—synergistically, I guess, expanding all this research that's available to us, it seems to me, here's an opportunity.

Seize that opportunity while it's here, while there are people expressing that desire. Maybe there are going to be some difficult things that we're going to have to clean and clarify, but let's make a start. We can't get it done without beginning somewhere.

Mr. WALGREN. I thank you.

Let me ask Congressman Michel at the outset, in the event that he has to leave—and I realize that's highly probable—just to expand on the areas of the waiving of the criminal restrictions on conflicts of interest. As I understand it, in your bill the Government employee would have a right to 15 percent of the royalties that might flow from a development that came out of, I gather, a collaborative agreement at that point.

Mr. MICHEL. Yes.

Mr. WALGREN. And I suppose the obvious concern would be that it would focus their interest so completely on that function that they might no longer be considered Government employees in some sense, and there apparently are some conflict of interest limitations——

Mr. MICHEL. Yes.

Mr. WALGREN [continuing]. And I confess not to know the boundaries of those as well as I should, but perhaps you would like——

Mr. MICHEL. And I'm not all that well versed in it, except to say—in addressing the entire subject matter, no one has been more conscious of the fact that you're a Federal employee, and you have certain obligations as a Federal employee without—and focusing in on your job. But it just seemed to me that those folks who do that tremendous job that I've seen done in some of these areas, the things that have come forth, they ought to be given some incentive or bonus award. We've had this—I forget what—this Executive Bonus Program that we enacted a few years ago to do just that, where some superior awards certain employees for whatever, bonuses that have been rather significant. As a matter of fact, sitting in this space room reminds me that one of our problems was that we were probably getting more in this area, in that space area, than we were in some of the other agencies of Government. And then I found, as laudable as the end was, that some of the employees, 50 percent, were getting the bonuses this year, and 50 percent were getting the bonuses next year—there's always a way to get around what we didn't want to have happen in the first place, and we had to correct it. And I remember writing a limitation, you know, no more than 25 percent to kind of cut down that abuse.

So, it works both ways and it may be, in the ultimate, that you're going to have to see fit, if everything else can move, to maybe not concede to that point. It's a difficult one for me to spell out for you, other than to hold out the carrot, the opportunity that "Gosh, this individual ought to be given some kind of reward for that exceptional job that he did in getting us to wherever we are at the time."

Mr. WALGREN. I had one other bell that rung, among others, in your testimony, and that was the idea of some of our intellectual property developed in these laboratories being used abroad when we essentially defaulted on it. At that point, I would gather that we didn't want it to be used abroad, but it was there and the Amer-

ican system, because of the limitations in our pickup on these ideas, didn't pick it up.

I gather that's more our default than it is a real loophole in the system——

Mr. MICHEL. Yes.

Mr. WALGREN [continuing]. That allowed that to get out?

Mr. MICHEL. Yes, because we're so restrictive in our own licensing procedures here at home, whereas abroad, you know, there just aren't those tight restrictions. So much of this is in the public domain. They can pick up on what's there and run with it. And we foreclose our own people from doing that very same thing. Now, there's—I don't know exactly how we address ourselves to that, but when you look at it from afar off, you say, "How can we permit this to happen?" Something's got to give someplace, and I'm not sure I'd want to say, "Build another wall" against anybody using it. It flies in the face of what we're doing in the first place by spending so much for research initially. I guess I'd just like to see it given a much more freer opportunity to bloom and grow than what we've encased it with, with undue restrictions and licensing procedures and all the rest.

Mr. WALGREN. I see.

Would any of the other gentlemen—Mr. Henry, would you like to ask anything of Congressman Michel at this point before we turn to Dr. Nam Suh?

Mr. HENRY. Thank you, Mr. Chairman. I'm looking forward to hearing from the rest of our panel, and also hearing from the people from Mr. Michel's district. I am particularly concerned about how this is going to impact developmental efforts of our local communities, and I noted that Mr. Michel mentioned that. I'm looking forward particularly to getting into that area. Thank you.

Mr. WALGREN. Well, thank you very much.

Mr. MICHEL. Thank you, Mr. Chairman.

Mr. WALGREN. Dr. Suh, please proceed.

STATEMENT OF NAM P. SUH, ASSISTANT DIRECTOR FOR ENGINEERING, NATIONAL SCIENCE FOUNDATION

Dr. SUH. Mr. Chairman and members of the subcommittee, I am pleased to provide the Foundation's views on technology transfer activities at the National Science Foundation.

As you know, Mr. Chairman, the National Science Foundation is not authorized to operate any Federal research laboratories. The research centers we support are operated under contracts, cooperative agreements, or grants to universities or consortia of universities.

National Science Foundation does support a number of major programs that involve technology transfer between universities and industry, and we view these hearings as an opportunity to highlight some of these efforts.

We appreciate the desire of this committee and that of our authorization committees in the Senate to come to grips with the problems associated with technology transfer and utilization and explore options for strengthening the U.S. position in these areas.

National Science Foundation has taken a number of actions recently that are aimed at strengthening and expanding interaction between industry and universities in areas that will aid technology transfer and utilization. On April 3, 1985, the Foundation announced the establishment of six Engineering Research Centers, including a Microelectronics Center at the University of California at Santa Barbara; a Telecommunications Center at Columbia University; a Biotechnology Center at MIT; an Intelligent Manufacturing Systems Center at Purdue University; a Systems Engineering Center at the University of Maryland, in collaboration with Harvard University; and a Composite Manufacturing Center at the University of Delaware, in collaboration with Rutgers University.

In addition to helping U.S. industry maintain its industrial competitiveness, the Engineering Research Centers are committed to providing more hands-on and engineering systems-type experience for graduate and undergraduate engineering students, and to strengthening the theoretical aspects of their education.

We believe that the Engineering Research Centers will be major contributors to national efforts to improve U.S. industrial competitiveness. That view is shared by both universities and industry.

Another Foundation program that is directly involved in the transfer of new knowledge and technology is the Industry/University Cooperative Research Centers Program. The Industry/University Cooperative Research Centers are smaller and more sharply focused on industrially relevant research than are the Engineering Research Centers, which have a much broader mission. Currently, the National Science Foundation is supporting 20 of these centers, which are at various stages in their development. A requirement is that each of the centers must become totally self-sufficient after 5 years of operation. National Science Foundation funding stops at that point. Research at these centers is focused on numerous areas of technology, including robotics, ceramics, materials handling, optical circuitry, computer graphics, welding, and others.

Another program contributing to technology transfer is the Foundation's Industry/University Cooperative Research Projects Activity. This program is a catalyst for expanding industry/university collaborative research. Research proposals that are determined to be industrially relevant are eligible for support under this program, provided there is substantial cost sharing. Areas of research focus in this program currently include computer engineering, chemical process engineering, and materials.

National Science Foundation has increased its computer science programs, and we recently initiated a special program to give researchers in all fields of science and engineering access to supercomputers. We expect that applying the power of supercomputers to some of the most complex research questions in such fields as engineering, materials science, and chemistry should speed us along toward new and beneficial technologies.

As you know, a number of years ago, National Science Foundation was assigned responsibility for the funding and oversight of a number of Materials Research Centers that had been the responsibility of the Department of Defense. The goals and programs of these centers were revamped. Today, National Science Foundation

funds 14 Materials Research Centers located at universities across America.

In connection with technology transfer and utilization efforts, the Foundation recognizes that State and local governments are a key factor in mounting efforts to enhance U.S. industrial competitiveness. High technology firms create jobs and help in building strong economies. The Foundation has a program called the Experimental Program to Stimulate Competitive Research or EPSCOR. The objective of this program is to enhance the research capacity of academic institutions in States that have been relatively less successful than others in competing for research support. The involved States and local governments have taken great interest in this program. These are collaborative efforts with universities, State and local governments, industry, and National Science Foundation working together to find ways to build strength in academic research laboratories. Many industrial firms have taken an interest in EPSCOR because it provides an opportunity for upgrading science and engineering programs of universities and colleges upon which they rely for trained engineering and science graduates.

Currently, National Science Foundation is supporting research projects being conducted in about 200 small, and mostly high technology, firms through our Small Business Innovation Research Program. About 50 percent of this research is concentrated in engineering fields, and there is significant technology transfer and utilization occurring as a result of these efforts.

The National Science Foundation is concerned about the need to make effective use of federally funded research laboratories, including those that are operated by the Government and those operated under contract by others. I believe that our overall objective should be to stimulate technology transfer and utilization through wider and more effective use of Government laboratories. But we believe the location of the proposed Federal Laboratory Consortium for Technology Transfer in the National Science Foundation would be of questionable value. Much more might be achieved by re-examining the goals and objectives of the Government-owned laboratories and revamping their missions. These laboratories represent a great resource for America. They can benefit, I believe, from more interaction with universities and industry.

The President's Science Advisor and others in the administration are examining the role of the Government-owned laboratories. I believe there is a strong desire on everyone's part to make it possible for industry, universities, and the public in general to benefit from these laboratories to the maximum extent possible. Numerous options, including those contained in the proposed legislation, are being considered. The administration is studying the legislation and will comment on it later.

This concludes my oral remarks, Mr. Chairman.

[The prepared statement of Dr. Suh follows:]

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This concludes my oral remarks Mr. Chairman.

Mr. WALGREN. Thank you very much, Dr. Suh.

Let's turn, then, to Paul Houck from my State of Pennsylvania. Welcome to the committee, Dr. Houck. We appreciate your being here.

STATEMENT OF PAUL W. HOUCK, INFORMATION COORDINATOR, PENNSYLVANIA TECHNICAL ASSISTANCE PROGRAM, PENNSYLVANIA STATE UNIVERSITY

Mr. HOUCK. Thank you very much, Mr. Chairman.

I have two quick remarks. First, I want to tell you that it is a little unsettling to sit here, looking out of the corner of my eye at Congressman Michel who, from this angle, this profile, his appearance and his sound, looks remarkably like a former Member of Congress named Lyndon Johnson. [Laughter.]

Mr. MICHEL. I've been accused of worse, I think. [Laughter.]

Somebody said I looked a lot like Gorbachev. [Laughter.]

Mr. HOUCK. Well, whatever.

Mr. WALGREN. I won't touch that. [Laughter.]

Mr. HOUCK. You asked the previous panel about the possibility of a cabinet-level position in science and technology, and I just wanted to comment that there is a significant focus needed, of course, in this area, but there is a noticeable trend among universities now to pull technology-type emphasis out of engineering, out of science, out of education units within their university structure, and to separate them into their own operational units. So we are coming up with schools of, colleges of, divisions of technology in many universities across the country. So, the awareness of technology's importance is catching on on campuses around the country; maybe it will catch up with Government one of these days, also.

Before I summarize my prepared remarks, I should explain that PENNTAP is a statewide service operated in partnership by the Pennsylvania State University and the Pennsylvania Department

of Commerce. Our services are provided without charge. We restrict our expertise to the engineering and scientific area. We are a university function, but we do take on special projects for State and Federal Government organizations.

The issues that your committee are discussing today and tomorrow are of prime concern to PENNTAP and to many of the national organizations in which we are active. Technology transfer and related legislation holds a prominent role in the economic well-being of this country. Gaining full understanding and appreciation of that fact in these halls and in academic circles is usually a challenge, even though it is essential.

You asked for comments on H.R. 1572 and H.R. 695. I would first like to clarify—or have an understanding—on the definition of technology transfer. It is so widely misunderstood and misapplied, so absurdly so, that several years ago, for example, a representative of a foreign government was apprehended in California after stealing classified information from the Hughes Aircraft Co., that an FBI agent called the whole incident technology transfer. Espionage is not technology transfer. Neither is distribution of preprinted material that may or may not be appropriate for their need. Nor is it delivery of a lecture, as many engineers and scientists believe. It is a rare situation when an engineer or a scientist has an interest, and certainly the ability, to communicate technical information to nontechnical people. And that's what technology transfer is all about.

Transfer involves three amenable parties: the source of the information, a user or potential user of the information, and the agent or middleman who takes it from one side to the other, the bridge.

At PENNTAP, we regard the field of technology as involving four steps. One is research and development. The second is adaptive engineering. The third is information dissemination and application, and the fourth is education and training. It is from this perspective that we review technology transfer and that we look at the legislation that you're reviewing today. We look at H.R. 695 as basically an R&D bill, although it is identified in other ways. It addresses R&D issues. There is little thrust for public use of technology.

In both H.R. 695 and H.R. 1572, the voluntary aspects could create confusion for potential R&D partners with Government or with each other. In other words, the private sector research people and the university sector research people are never quite sure which Government agency, which Government division is in or out so far as the compliance aspects of the bill are concerned.

Section 11—the amendments proposed in this area are of special interest to PENNTAP. We have been enthusiastically supporting the work of the Federal Laboratory Consortium and the potential it has as the lead role in any sincere Government effort to transfer Federal technology. We do have reservations about its affiliation with NSF. We think a more appropriate location would be the Department of Commerce. The reason is that NSF has many strengths in science, in research, and has made many contributions. And we realize there are many internal political struggles that could be involved in shifting the Federal Laboratory Consortium from one agency to another. However, Department of Com-

merce has the stronger commitment to and experience in the practical side of dealing with and delivering services to the public. NSF, for all of its other values, is not known for its outreach, especially in the commercial areas.

We endorse subsection (3)(E), which involves requests for assistance from Federal agencies. A number of Federal labs, of course, were doing this even before the Stevenson-Wydler Act. One of the reasons that the Stevenson-Wydler Act was not an influence on the PENNTAP operation is that we had the contacts pretty well in place before it was enacted, and for a number of years we have been dealing with several technology transfer specialists within the Federal labs. One was Mr. Jerome Bortman at the Naval Air Development Center at Warminster, PA. Another was James Wyckoff at the National Bureau of Standards.

I could give you a number of examples where PENNTAP is involved with Federal labs and the value of the Federal lab technologies. I would like to cite one—and earlier I think you, Mr. Chairman, asked somebody about the matter of defense-related technologies having value in the public sector. A number of years ago, PENNTAP investigated the Navy's Preventive Maintenance Program. We took a number of people down to Dahlgren, VA, looked at the military aspects very carefully with the idea of transforming them into public or commercial use. We did so, set up several pilot projects with a university, with a private company, with a school district. The values turned out to be tremendous. We keep getting back—since we started transferring this technology in preventive maintenance to several hundred institutions, private industries, and school districts—we have evaluations that mention thousands of dollars of savings, $50,000, $100,000. One city had as much as $3 million in savings just from this one technology transfer from a Federal lab.

At the same time, we have provided assistance to Federal labs. In one case, we worked with the Navy. They were concerned about computers on board ships, the heat and the fire resistance problems. We found the technology that reassures them that they really didn't have a problem. Another time we worked with DOE on a matter of extracting uranium from seawater. We work frequently with NTIS and with CUFT, which was created under Stevenson-Wydler.

I think Stevenson-Wydler suffered, of course, because it was generally ignored in funding; but even if funding had come through, we thought it was destined for the same fate, largely because it does not challenge, it does not demand, and it does not require results. It requires reports, but not results. Without motivation and without measurement of goal achievements, these types of things simply don't come about.

We measure results through evaluations. We have a very strict program. We know, for example, that over the past 13 years on the basis of what our users have said, that the economic benefits from our program have reached $80 million.

Last year, the users reported benefits of over $10 million, and the last 2 years they've told us that we've helped them develop or improve 55 new products. In the last 5 years they've told us that we've had a hand in creating or saving more than 500 jobs. We

know by careful bookkeeping that we run a cost-benefit ratio of 17.2 to 1, which means that for every dollar that the university or the State government or the Federal Government puts into our program, we're bringing $17.20 back into the economy. We do this as high-caliber, full-time specialists, engineering and scientific types, academically qualified with doctorate degrees, all with experience in industry. They are not part-time faculty or graduate students. Yet, our operating budget has never gone over $500,000. This shows what a small staff can do. And since we have demonstrated what a small, disciplined program can do consistently, the question is, What impact would a national network of similarly structured programs have on the national economy? And that could be a critical question for this committee.

Here we have a major act, Stevenson-Wydler, approved but not funded. We have two amendment propositions probably facing the same fate. Nothing we say here will mean much unless we're sensitive to the freeze and deficit debates. Yet, we're talking about a very critical issue; it can make a difference in our growth. PENNTAP, for one, has demonstrated that technology transfer is effective. The Government is spending billions to create new knowledge, and pennies to distribute that knowledge. So, technology transfer needs a legislative mandate, and not a voluntary exercise, for a coordinated national program for utilization of technology wherever it is needed in the grassroots of business and industry. With one exception, everything is in place for such a system. We have the technologies; we have the renewable resources, our brain power in Government and universities; we have the experience of several States in transferring technology; we have the need, certainly, in the marketplace. We don't need further studies to tell us what we need. We need a mechanism for a practical national transfer and delivery system to make this, to coordinate this. We feel it is beyond the scope or the interest of Federal agencies.

The fundamental question is whether the Federal Government is serious about making available the results of its multibillion R&D investments. If it is serious, there is a wide open, immediate opportunity for Congress to move into productive partnerships that will turn over the Federal dollar many, many times, enriching the economy, growth, employment, and technological innovation. Thank you, Mr. Chairman.

[The prepared statement of Mr. Houck follows:]

PREPARED STATEMENT OF PAUL W. HOUCK

Mr. Chairman, I thank you for this opportunity to offer this committee comments and suggestions based on PENNTAP's 20 years of experience in the field of technology transfer and dissemination.

Before I discuss particular legislative proposals, I should explain that PENNTAP is a statewide service which is operated as a partnership by The Pennsylvania State University and the Pennsylvania Department of Commerce. Our mission is to assist in the transfer and application of technical information in ways that will ultimately result in economic improvements. Our services are offered without charge. We restrict our expertise to engineering and scientific areas. While we are considered as primarily a University function and we do operate from facilities provided by Penn State, we do take on special projects for state and federal agencies. Currently, for example, as part of the U.S. Department of Commerce's Economic Development Administration, PENNTAP operates Pennsylvania's University Center with a special task to assist small businesses in the area of advanced technologies.

The issues before this committee today and tomorrow are of prime concern to PENNTAP and to national organizations in which we are involved. Technology transfer and related legislation have and should continue to hold a prominent role in the economic well-being of this country. Gaining full understanding and appreciation of that role . . . here, in the halls of Congress and in academic circles . . . is a necessity, if not sometimes a challenge.

You have asked specifically for comments on H.R. 1572, the Federal Science and Technology Transfer Act of 1985, and H.R. 695, the Federal Laboratory Technology Utilization Act of 1985, both of which are concerned with the Stevenson-Wydler Act of 1980. You have also asked for comments and suggestions on how Federally-funded research and development can more effectively be brought to the marketplace.

I believe it's essential, at this point, to have an understanding on the definition of "technology transfer.' It is a widely misunderstood term, often grossly misapplied . . . and perhaps the most extreme use ever was heard a few years ago after a representative of a foreign government was apprehended for negotiating the theft of classified material from the Hughes Aircraft Co. . . . an FBI agent called the incident "technology transfer."

Agencies sending out pre-printed information which may not even be appropriate is not technology transfer. We hear engineers and scientists talking about transferring technology when all they have actually done is delivered a paper of a lecture. Historically, scientists talk among themselves and not to the real world. Small numbers of the engineers, scientists, the research and development people, have an interest or the ability to communicate technical information to a non-technical audience—and that's what is almost always involved in technology transfer.

When we speak of technology transfer we speak of a mission, or a goal. When we want an actual transfer to take place—technology to be moved from a research source, such as a Federal lab, to the marketplace, such as a small company that will use the technology—then we should speak in terms of a technology transfer agent. In other words, for technology transfer to take palce, three factors must be present: the source, the transfer agent or middleman, and the user.

I realize this is drawing a line, but when you are reviewing legislation designed to achieve utilization of federal technologies, for example, that line makes a critical difference.

At PENNTAP, we regard the field of technology as involving four steps, starting with (1) research and development, followed by (2) adaptive engineering, (3) information dissemination and application, and (4) education and training.

It is with this perspective that we have watched the attempts to implement the Stevenson-Wydler Act's provisions and with which we have reviewed the proposals to amend, H.R. 1572 and H.R. 695.

From our standpoint, therefore, H.R. 695 is designed primarily for research and development although it is identified as a Bill to improve the transfer of technology from Government laboratories to the public. Its provisions address R&D arrangements and appropriate safeguards and custody and protection of research conducted jointly by Federal labs and others in Federal, state, private settings. Our reaction is that the thrust is not toward moving any of the research results to the public.

PENNTAP does not conduct research and development activities, although it often links organizations with private, university or Federal labs with capabilities in particular areas . . . and we were among the first organizations to pick up on the Small Business Innovation Research (SBIR) opportunities and to promote the program among Pennsylvania's small research firms.

You, Mr. Chairman, and others form Pennsylvania are aware of the Ben Franklin Partnership program which places special emphasis on cooperative research by universities and industry. After some early hitches over the questions of research ownership and use, that program seems to be moving ahead. We do not hold any disagreements with the purposes of this Act; however, we do recall that both the SBIR program and Stevenson-Wydler had "voluntary" provisions which allowed some agencies to resist implementation. Unless the mission is specified and across the board, it results in confusion and discouragement among the potential cooperative R&D organizations.

Our stance would be the same for the sections of H.R. 1572 which refer to cooperative research.

The amendment to Section 11 of Stevenson-Wydler—establishment of the Federal Laboratory Consortium for Technology Transfer in the National Science Foundation—is of special interest to the PENNTAP organization. We are enthusiastic about the work of the FLC and the potential it has for performing as the lead role in any sincere Government effort to transfer federal technology to where it is needed in the marketplace. We do, however, have reservations about its affiliation

with NSF. A more appropriate location for the FLC would be the Department of Commerce.

Here's why we feel this way about FLC's home base:

NSF's strength is in the science area, in research across a wide variety of issue areas. I don't have to recite a list of contributions it has made to the field of scientific study. I mentioned earlier that PENNTAP conducts special projects for government agencies; one of these in the 1970's was with NSF on "The Delivery of Public Technology: A Pennsylvania Experiment."

On the other hand, we believe that the Commerce Department has stronger commitments and experiences in the practical side of dealing with and delivering services to the public and private sectors. For all of its valuable work in science and research, NSF, nevertheless, is not known for its outreach, nor for its sustained support of public service programs. And that, after all, is what FLC needs to do and what its members feel obliged to do—serve the public by coordinating transfer agent efforts to enable utilization of federal technology.

To overcome weaknesses which developed in Stevenson-Wydler, Section 11's new proposed additions should be adjusted to assure that cooperation of Federal labs with the consortium is part of the mission and not be allowed to fester on a voluntary basis. As stated earlier, if the cooperation is not universal the entire effort will fall short of the goal. Frankly, we're puzzled over the fact that the loophole of "voluntary" cooperation is included at all.

We heartily endorse the proposed subsection (3)(E) which calls for the FLC to receive requests for technical assistance. A number of labs and consortium members have been functioning in this manner, even before Stevenson-Wydler.

One of the reasons Stevenson-Wydler has not really had any influence on PENNTAP's operation is that we had established contacts and technology exchanges with federal sources before its passage. For a number of years, our principal contact has been Mr. Jerome Bortman, who is part of the Federal Laboratory Consortium, working out of the Naval Air Development Center at Warminster, Pennsylvania, as the technology transfer coordinator for the Mid-Atlantic region. He sits as a special resource person on our industrial Advisory Council.

PENNTAP has had a successful track record in using federal resources due largely to Mr. Bortman's resourcefulness in helping our technical specialists find and gain access to the information harbored in Federal labs or other despositories. We are quite aware, certainly, that Mr. Bortman's office has many other calls for assistance from the private and public sector and that he has been not only helpful but very successful in bringing technologies out of the federal system into the marketplace.

There are other government personnel who demonstrate a dedication to technology transfer and dissemination. One is Mr. James Wyckoff of the National Bureau of Standards, another resource frequently used by PENNTAP. Mr. Wyckoff, who is current Washington chapter chairman of the National Technology Transfer Society, has been most cooperative over the years, in an active way and in responding to our technical specialists.

It would help, I believe, if I told you about some examples of federal technology transfer involving PENNTAP.

One of the most successful came in the mid-1970's when we learned about a preventive maintenance program developed by the Naval Facilities Engineering Command (NAVFAC). Scanning the numerous manuals and publications produced for the program, we realized its possibilities were enormous. So, we took a small group of potential users to the Naval Weapons Lab at Dahlgren, Virginia, for a demonstration, then had these same people participate in a pilot experiment on the program's non-military effectiveness. We believed many institutions and companies were simply unaware of how much money they were losing by the lack of proper preventive maintenance procedures. The pilot program was successful, proving our point. Since then we have passed that program to hundreds of companies, hospitals, school districts, colleges. Evaluations from users mention ". . . $40,000 saved in one year . . . $200,000 . . . $60,000 . . . $25,000 . . . ," etc.; millions in savings from one transfer of technology from a federal resource.

PENNTAP's use of federal bases has been diverse and includes cooperation from a number of locations. A sampling:

DOE's Oak Ridge lab provided computer printouts of materials on the use of compressed air for energy storage.

Argonne National Laboratory supplied reports of research data on batteries for electric cars.

NASA assisted in getting together the developer of the spacecraft splash-down float collar with an inventor in Pennsylvania.

Army Cold Regions Lab in New Hampshire provided ideas to assist in solving a problem with operations of a front end loader in cold temperatures.

Brookhaven National Laboratory provided data on the use of polymeric concrete being cured rapidly with radiation.

DOE's Livermore Lab helped us with a state-of-the-art report for solving the problem of removing frozen coal from railroad hopper cars.

National Bureau of Standards shared with us data on the use of used oil, a subject of numerous inquiries.

Department of Transportation assisted in developing a plan to cope with a hazardous material spill.

U.S. Fire Administration assembled information which PENNTAP in turn has used to assist nearly 200 communities in developing master plans for fire protection.

Department of Agriculture provided information related to silo fires and PENNTAP's fire and safety specialist and a Penn State colleague further sophisticated a silo fire-fighting system which has received nation-wide attention and use.

Naval Air Development Center assisted in developing a contract to provide helicopters for high rise fires and marine rescue.

The same facility linked PENNTAP with Federal labs specializing in anti-static technologies when a company making polyurethane containers feared problems with flammable materials.

The exchange of such information depends heavily on the credibility involved; when it exists in the form of understanding and respect, the exchange is usually smoother and more frequent. Professional competence at both ends is important because the information can and should go in both directions—from the federal resource to the university and from the university to the federal sources.

PENNTAP's staff has also provided assistance to federal personnel.

We have worked with the David R. Taylor Naval Research Lab and the Caderock Naval Lab on various occasions, including one instance when the Navy was concerned about heat and fire resistance qualities of computer and electronic equipment aboard ships. Among others, we have supplied information to DOE on such questions as extraction of uranium from sea water. Though it was an indirect return of technology to the federal government, I woiuld like to mention a case in which PENNTAP worked with a small firm in the development of a new product which I will identify only as an infrared camera imaging system. The product was selected as winner of Governor's Product of the Year Award in 1984. Because of it, a spin-off company was formed with sales projections of $1 million in its first year. We're told that the product is now incorporated into the space shuttle tracking system and is also being used for hydrogen testing tasks in the shuttle program.

I should also mention another federal resources which PENNTAP has referred to on numerous occasions, the National Technical Information Service. NTIS and CUFT, the Center for Utilization of Federal Technology which was created by Stevenson-Wydler, provide a valuable tap-in service, a quick catalog look at what's available in federal locations.

I have given you this background to demonstrate PENNTAP's experience with federal resources, and, more to the point, to support our belief that the Federal labs and certain other requirements imposed by Stevenson-Wydler are legitimate areas for federal involvement . . . that the access function is not one that can be downgraded and allowed to deteriorate in the hands of nonspecialists . . . that an intensified federal linkage system, coupled with organizations such as PENNTAP, would have tremendous potential for economic development opportunities.

I realize the Stevenson-Wydler Act was designed to address these potentials. Nevertheless, in its comprehensive approach to technological innovation . . . in its broad brush attempt to cover the problem and the need, the Act, after four or five years, has not given us a technology innovation or transfer coverage. In reality, the only marks it has left have come from the Federal labs and, to some extent, from CUFT . . . otherwise, it has not contributed effectively to technology development.

If you look at what it has accomplished and what it has not accomplished among its original goals, there is a rather clear indication that the mission went astray. The point is that 96-480 imposed upon itself tasks which generally confronted the "forest" rather than the "trees." Its generalities obscure the targets. Even if funding had come through, to match there is doubt the Act's accomplishments would have improved. Part of the reason is in interpretation of what technology transfer is to achieve.

When PENNTAP is asked to review proposed legislation or other technical assistance plans, the factor we look for first is a clear indication of motivation to achieve results. We don't always find motivation well defined, but even when it is present, we then look for the real clue, evidence that results will be evaluated or measured.

It's the exception when you find a program which makes a sincere effort to measure the results, the achievements of its effort—not the activities of the organization. PENNTAP's entire philosophy, and operation, are geared to producing results with an absolute minimum of paper work, red tape. We do not count "eyeballs" or phone calls or hours spent on this or that type of service. In contrast, many government programs force universities and contract performers to play games with artificial activity statistics that are counterproductive, have little practical use, and contribute nothing to the goal of the project. Quality and results come from the credibility of personnel and the information transferred, not activity. Of course you have to have activity to produce results, but you have to make certain your emphasis is properly placed.

I would like to illustrate why measuring results is important.

After we provide assistance, at a point when we believe the user can measured improvements or achievements, we ask for an evaluation—not of our service, but of what has happened as a result of our services. Not all cases involve answers and solutions which can be measures by dollars and cents, and not all users return the evaluations, but on the basis of an average 45–50 percent return of evaluations and the statements made by users, the known economic benefits credited to PENNTAP's assistance from 1972 through 1984 was just under $80 million.

The benefits reported by users during 1984 totaled $10 million. These figures do not include other factors which have an impact on the economy, such as residual benefits, capital investments in equipment and buildings, or in new product development, or in jobs. In 1983 and 1984, our PENNTAP users indicated we helped with the development or improvement of 55 new products. In a five-year period ending with 1984, users told us we had a hand in creating or saving over 500 jobs.

Another significant statistic that's relevant to this discussion: This kind of effective technology transfer can be cost-effective. PENNTAP's operating benefit:cost ratio average is rather impressive 17.2 to 1 . . . which means, of course, that known economic benefits—not counting the impact of new products or new jobs—have been returning $17.20 to the economy for every $1 invested in PENNTAP by the University, the State or the Federal government.

Another important factor: I note for the committee that our technical specialists or transfer agents are full-time, high caliber professionals, engineer-scientist types, not part-time faculty or graduate students. Yet, at no time has PENNTAP's operating budget exceeded $500,000. When you know that approximately one-fourth of our cases involves travel from on-site visits and that we have very large postage and telephone bills, it is not difficult to realize that we must operate with a relatively small staff. And we do—seven to ten technical specialists depending on the projects we have under way. We respond to between 1,200 and 1,300 cases each year; business and industry account for 55 percent of these numbers. I have cited these PENNTAP statistics for two reasons:

(1) If a relatively small technology transfer organization following disciplined procedures and philosophies and using professional specialists to perform one-to-one transfer functions can cause economic benefits amounting to $10 million, or $8 million, or $12 million in one year and also be instrumental in creating new products and new jobs, what impact would a network of similarly structured organizations have on the national economy?

(2) PENNTAP, or any information transfer system, is only as effective as its personnel and its base of information. I've mentioned the attention PENNTAP gives to choosing qualified personnel. However, with the perpetual turnover of knowledge and the near avalanche of new technologies in recent years, no one organization or person can be 100 percent current—the total expert possessing all answers. Therefore, the key to successful and practical transfer is access to and linking of the best available resources. To PENNTAP, the best available resource is any person, organization or association that can supply a possible solution to an existing problem . . . . or produce a technology that appears to have potential for application and economic impact in Pennsylvania. In countless cases during the past seven or eight years, the "best possible" resources utilized by PENNTAP has been a federal facility.

I cannot give you a dollar figure on the extent of the impact federally-based information has had on our state's economy, via PENNTAP, but I can assure you that the $80 million total I mentioned earlier would be much lower if we had not been able to turn to federal sources.

Thus, if this committee is looking for evidence or reassurance that federal dollars spent for technology dissemination is paying off, is helping to create or save jobs—you can find it in Pennsylvania. Obviously, if you ask if a cutback in the federal programs directly involved in technology transfer or in supporting technical deliv-

ery would have a serious affect on the nation's economic growth, our reply again would be "yes, very serious."

I would like to provide you with more details on PENNTAP's cooperative relationship with various federal resources, but first, and at the risk of sounding presumptuous, I believe it would be helpful to the committee to understand that my statements reflect not only my opinion but also the philosophy and position and the status of PENNTAP—helpful to the extent that you know where we're coming from . . . and it's not just as one of the oldest technology transfer organizations in the nation. PENNTAP's system has been identified as a model for technology transfer. Louis Rukeyser, the syndicated columnist and commentator, examined our program a number of years ago and called it the most sophisticated in the nation. A team of academic administrators assembled from around the country conducted an in-depth study a few years back and observed that PENNTAP is a model other states should emulate. In fact, during the past four years alone, 37 states and 14 foreign countries have come to PENNTAP for assistance in setting up or in refining technical assistance programs. Our director, Dr. H. LeRoy Marlow, has appeared before a number of Congressional committees. He is the immediate past president of the National Association of Management and Technical Assistance Centers (NAMTAC), an organization which includes among its members the University Centers sponsored by EDA, as well as other federally-endorsed assistance centers. He is chairman of the National Productivity Network and is active in the national Technology Transfer Society. Among others, PENNTAP designed a technical assistance program for Venezuela several years ago and we were recently invited to Great Britain to consult on arrangements for transfer units.

I call your attention to this PENNTAP background only to re-affirm our position and our understanding of the technology transfer needs and potential to our country.

One of the factors relative to our successes over the years—and relevant to the federal involvement—is our very active Advisory Council. This is a group of business and industry executives, appointed by the president of Penn State, who each year volunteer about eight days of their time in meetings, task forces and travel to help us stay on the cutting edge of business and industry trends. They help us determine policy, plan technology awareness events, support our efforts within the University, state government and elsewhere to keep our specialists and the organization updated and tooled to sustain our ability to respond to the Commonwealth's needs. To add to its own expertise and experience, the Council utilizes resource persons who have specialized backgrounds and serve continuously as part of the group.

Mr. Chairman, you asked for legislative suggestions on how federal technologies can be used more effectively in practical ways and what improvements can be made in the federal effort to accelerate U.S. technological innovation.

I would assume that your hearings today and tomorrow will bring forth any number of suggestions. But unless they are sensitive to the budget freezes and the deficit debates, it is doubtful any of the suggestions will be worth the time your committee takes to examine them.

Therefore, the cost: benefit perspective would seem to be a logical approach for any legislative initiatives, and that will be the basis of these comments.

I have recited PENNTAP's track record for economic impact—a small, disciplined program creating in a 13-year span known economic improvements amounting to $80 million, plus new jobs and new products. A properly managed technology transfer and dissemination system can have tremendous impact. . . and produce economic impact far in excess of its cost of operation.

The Government has been spending billions of dollars on research and development on an annual basis; it has a mammoth warehouse of technologies with a potential for application in the public and private sectors. Despite various kinds of programming attempts, the Government has not really found an effective and consistent method for making the technologies available. The Federal Lab Consortium has helped to open some doors and dust off some shelves but mostly on a voluntary basis.

Thus, specifically what is needed is a legislative mandate—not a voluntary compliance exercise—for a national program for the utilization of existing and forthcoming technologies where they are needed and can be used to create economic growth.

With one exception, we have everything in place to implement a viable technology application system, one that would tie all of our resources together on a national scale and create a channel in which technology could flow to meet the demand or to create a demand.

We have the technologies and the brainpower in government, universities and the private sector to sustain our position. We have the vast information base within the Federal Government and some access to this valuable resource. We have the universities as another prime source for information and backup, needing only the motivation for public service outreach. We have state governments eager to stabilize existing economic bases, to diversify and to move with technology developments. Additionally, we have the experiences from several states which have taught us important lessons about technology transfer itself. One lesson is that technical information simply cannot be dumped, or broadcast, or even given in printed form in response to a particular need, if it is to be effective . . . if it is to produce the expected or best possible results.

With all of these positive factors in place, we have on the other side of the economic scene a ready market for business, industrial and institutional applications. We know that small business generates the power for our economy. We also know that small business is where the most help is needed to find and to apply technologies...where the enterpreneurial spirit is born and nursed. We don't need further studies, policy conjectures or theoretical economic exercises to verify all of this.

There is, however, one missing ingredient, a missing link that prevents the potential from really developing, and that is the mechanism for a practical national transfer and delivery system. A small number of states maintain their own systems devoted to pure technical missions. There are technical assistance programs in many states, but they are fragmented by types of services offered and expertise available.

What is suggested here is beyond the design of the Stevenson-Wydler largely because it represents a de-centralized approach. The operational pattern should fit a national model, geared with fundamental principles oriented toward producing results, but technology thrusts would have to vary according to state or network member needs. It also would be beyond the scale of services that could be provided by Federal labs, NTIS, CUFT, NASA, OPTI or other agencies since they are limited in how far they can reach . . . or, as a matter of fact, in how far they want to reach. As you know, it has been the resistance by some agencies, not necessarily those I've mentioned, which has been a deterrent to Stevenson-Wydler implementation.

The thought is that this committee's concerns about the status of Stevenson-Wydler and its potentials . . . about the impact of the Federal labs, in regard to the general question of utilizing federal technology . . . could more appropriately include concern about the Federal role in helping to provide the missing link, the stronger bridge between what the government is now doing and where the technology can be applied. The linkage, the essential mechanism has been talked about and legislated around; but the fact is that it is missing.

It is no longer a question of determining what kind of bridge would work best—that has been proven and successfully demonstrated. The fundamental question is whether the Federal Government is really serious about making available the results of its multi-billion dollar investments in research. If it is sincere, then there is a wide open opportunity for Congress to move into productive partnerships with state governments and universities . . . cooperative ventures as part of a national network of centers whose primary mission would be to transfer science-engineering technologies. The impetus to bring this economic enrichment force together must come from the Government.

If Congress would pursue that course, it would eliminate the paradox that now exists—on one hand the steady and necessary expenditure of billions of dollars for scientific exploration in research and development, but on the other hand, inadequate and yet equally important funding of vehicles that can carry the research results to the marketplace for utilization.

Another perspective of this paradox involves the budget and the deficit. It is said that economic growth will provide the national stability needed to make tax increases unnecessary in regard to deficit reduction. It is also said that economic growth will depend heavily on our adaptability to the techonology revolution. Yet, the Federal Government—as the largest developer, the major clearinghouse for technology—is spending enormous amounts for that purpose while allowing a comparative pittance for distributing its technology to places where it can cause or be part of the economic growth.

By reinforcing the strength of its own technology transfer dissemination—especially through the Federal labs, for example—and offering a joint effort with states for a grass roots transfer and application network effort, the Government would be closer to and impact much sooner on economic growth and stability.

I will summarize quickly the basis for a national network and the principle guidelines for governing a technology transfer program that will work:

It should have a university base, staffed by full-time professionals from technical fields with special communication talents.

The service must establish access to multi-university sources, special libraries, federal/state/university lab and agency resources.

It needs rapport with professional and trade and labor organizations.

It must be readily accessible to potential users and be prepared for prompt reaction to requests for assistance, and also initiate delivery of technological information to potential users.

Most important, it must be built around the fact that technology transfer is a human activity, involving a qualified specialist or agent as the middleman or matchmaker between resource and need because . . . one-to-one exchange enhances credibility, reception and use of information and definition of problems . . . interpretation of technical data is essential if it is to be understood and properly applied by the user . . . availability of information is not enough; simply making reports, bulletins, etc., available does not ensure their use . . . possible solutions often require many resources before information can be assembled that fits the exact need . . . sustained contact, help and interest in a particular case, as well as follow-up, is often what inspires the user to continue action or development.

Before I close, I would like to touch briefly on two important areas of technology transfer systems which sometimes develop blemishes in Federal programs.

The first is the traditional Federal concept that projects must eventually become self-sustaining. PENNTAP has never charged for its services and here's why: If you have any public dollars in your budget, you can hardly justify any restriction on the type of clientele you serve. PENNTAP operates in a sophisticated field and we deal with all sizes and types of organizations. In a single day, a specialist on our staff might be in contact with a vice president of a major corporation, the owner of a small machine shop, the president of a research company, an entrepreneur asking for help in checking out a new product, and the maintenance engineer at a small college. At least half of our cases involve small companies.

You can't charge what your services are really worth; that would start you in business competing unfairly with private enterprise. How do you determine a fee amount? If you try a variable charge, then you have to find out sales volumes, employee totals, product values, etc. How do you charge an educational institution, a municipality, or a young entrepreneur about ready to launch his own business? But, even if you could arrive at a reasonable fee, you have to weigh potential income against the fixed costs of billing, bookkeeping and collecting. From our viewpoint, the profit margin would not be sufficient to make the ordeal worthwhile. A more important consideration: We know that large numbers of the people who call us for help would not do so if they had to pay for the service, regardless of the amount. The onus of a charge affects people in different ways, no matter how badly they need help. If the question of a fee is raised, our response is that the University and the State, or the University and the Federal Government are providing the service.

The second area is related. We do not believe that a service supported in part or entirely by tax dollars and using public facilities should compete with the private sector. I know that is not a common philosophy in many state and Federal service programs, but it should be. Our staff will go only so far in helping to find solutions. If a solution requires some type of special calculation or design, a new formula, a new equipment layout, etc., we back off. We will provide names of three or four consultants who specialize in that area, but the user makes the choice and the contact. We will suggest equipment needs and specifications, but do not recommend particular products by brand names.

To help us stay in line, we asked the Consulting Engineers Council of Pennsylvania to name a representative to our Advisory Council and it has done so for a number of years. Many consultants, in fact, use PENNTAP as a resource for their clients.

If PENNTAP has a general reaction to the two bills your committee is reviewing it is that they refer to technology transfer in general terms initially, but when you go through the provision line-for-line, they are actually addressing the narrow area of research and development and are not methods for utilization of technology in the private sector. So, essentially, what can happen is that the bills expand the R & D effort and further expands the stockpile of technology that is not being transferred to the marketplace.

Finally, Mr. Chairman, I can reassure you that technology transfer's time is here. If this country is going to maintain its position in the world's technology revolution,

the Federal government cannot back away from its leadership role; nor can it slight the fact that the revolution is, in reality, a technology evolution—an evolving turnover of knowledge, innovative expansion of known technologies, a borrowing from—building upon process that depends a great deal upon access to and transfer of existing technology.

To discourage, rather than to expand that effort, could be a critical mistake. To ignore or freeze a technology utilization effort for the sake of a comparatively few million dollars when that effort can turn over those dollars many, many times in the form of economic growth, could also be a critical error.

Thank you, Mr. Chairman.

Mr. WALGREN. Thank you very much, Dr. Houck. We appreciate that.

Let's turn to Mr. Neumiller.

STATEMENT OF C. RICHARD NEUMILLER, FORMER MAYOR OF PEORIA, IL, AND DIRECTOR OF LEGISLATIVE AND PUBLIC AFFAIRS, CENTRAL ILLINOIS LIGHT CO.

Mr. NEUMILLER. Thank you, Mr. Chairman. I do appreciate the opportunity to speak to you and the other members of the subcommittee in support of H.R. 695, the Federal Laboratory Technology Utilization Act of 1985, as introduced and commented upon this morning by our distinguished Congressman, Mr. Robert H. Michel of Peoria, IL.

I am director of legislative and public affairs for Central Illinois Light Co., or CILCO, as we are known in our service area, and we are headquartered in Peoria, IL. My basic responsibilities include representing the interests of CILCO before Members and staffs of the U.S. Congress and the General Assembly of Illinois. I am a native of Peoria and, with the exception of having attended college and serving in the U.S. Army outside of the city, I have been a part of that community all my life and certainly the economic viability of the Peoria area has always been of prominent importance to me. That concern is shared as well by CILCO.

On May 7 of this year I completed 12 years of service on the Peoria City Council and served both as a councilman and more recently as mayor of the city of Peoria. My opportunity to serve as mayor while an employee of Central Illinois Light Co. exemplifies the exceptional spirit in our community of the cooperation that has existed between the public and private sectors over the past several years, and further reinforces CILCO's deep commitment to the growth and development of the communities that it is privileged to serve.

As you have heard from Congressman Michel and will hear from Mr. Schneider in a few moments, Peoria, and our economic area, has not recovered from the severe recession that was experienced by many communities in the country in the early 1980's. Because of the worldwide recession and the strength of the U.S. dollar overseas, our major employer in the Peoria area, the Caterpillar Tractor Co., continues to experience losses in its income statement and to date has found it necessary to lay off approximately one-third of its area working force. Total employment for Caterpillar in the Peoria area has been in excess of 33,000, and Caterpillar is one of CILCO's primary customers.

CILCO is the principal subsidiary of CILCORP, Inc., a new holding company which was created May 8, 1985, following approvals

by both the Illinois Commerce Commission and CILCO shareholders. CILCORP was formed to implement a commitment by shareholders of CILCO to aggressively promote economic development within the CILCO service area by eventually making investments in other subsidiary ventures which will result in more jobs and sustained economic growth for that service area. CILCO is engaged in the generation, transmission, distribution, and sale of electric energy in an area of approximately 3,700 square miles in central and east central Illinois, and the purchase, distribution, transportation, and sale of natural gas in a similar but not identical service area of approximately 4,500 square miles.

Mr. Chairman, CILCO has always been an active motivator and participant in the economic development activities within its service area. When I served as a member of the Peoria City Council, I was appointed as a cochairman, along with a representative from the private sector, of a group that developed the recommendation which was adopted by the Peoria Area Association of Commerce that resulted in forming the economic development council for the Peoria area, or EDC, as we call it, in the early 1980's. EDC is the principal coordinating and promotional agency for economic development in the Peoria area. CILCO's chief executive officer was a charter director of that EDC, and that tradition continues to this present time. In addition, CILCO is also making a contribution financially to the operation of EDC, and further, in 1984 CILCO assigned a vice president to work full-time with EDC as a loaned executive. And Mr. Schneider is here today, and if it would please the chairman, I would appreciate the opportunity for Mr. Schneider's testimony to follow mine because that way I think the committee can get a basic understanding of how this project impacts and is important to the passage of H.R. 695.

Now, despite the severe economic impact that we have experienced in the Peoria area, we have in fact gone ahead and made some substantial improvements, again, on a public/private basis. Most significant is the $65 million civic center complex that was constructed and is operating in the downtown business district. This facility provides not only an arena that is capable of seating upwards from 10,000 to 12,000 people, depending on the event, for basketball, hockey, rock concerts, and so forth, it also includes a 100,000 square foot exhibition hall and a 2,000-seat theater that has one of the best acoustical balances of any facility in the State. All three of the facilities are interconnected, and they are ideally located to be mutually supportive of our area hotels.

Financing for this facility was made possible by the State of Illinois and local taxes on food, beverage, amusements, and hotel rooms. We required no increase in real estate taxes and no money was provided by the Federal Government. As a result of the civic center, Peoria's convention business is steadily increasing and is, in fact, a bright spot for our economy.

As a result of the public sector making this commitment, other significant developments have occurred in the private sector in terms of renovating and building new buildings. And I believe, Mr. Chairman, what is important for the committee to understand from my remarks this morning is that Peoria has not waited for things to happen. By using and creating resources, necessary im-

provements have been initiated to accomplish positive growth in our economy. Because of that we continue to look for opportunities and additional resources, and we believe H.R. 695 is such a resource for us.

Much time and effort has been spent in analyzing strengths in the Peoria area that could translate into future economic activity and jobs. One of our local assets is the Northern Regional Research Center of the U.S. Department of Agriculture. Economic analysis done by the community indicated that quite possibly there could be opportunities to work with this Federal laboratory as a result of the research and development done there which could, in fact, lead to the creation of business and job opportunities in our area.

As efforts proceeded to make contacts with both the Department of Agriculture and the Department of Commerce to determine whether it would be possible to transfer technology from the Federal laboratories to the private sector, we became aware of H.R. 695 and the positive impact that it could have on the economic development aspects of sharing research.

This legislation provides the opportunity to work fully with the Federal laboratory in the Peoria area to accomplish a restructuring of our area's economic profile. We are particularly supportive of the bill's provisions which would enable directors of Federal laboratories to enter into cooperative agreements with private business and to enable the laboratories to license such businesses for exclusive use of patents developed within the laboratories.

We are also particularly pleased to note that the bill includes an incentive where royalties not only become available to the laboratories, but will be shared with those responsible for the respective research and development.

We also applaud the bill's simplicity and directness, to bring about a decentralization of these activities which would authorize each agency of the Federal Government to permit directors of laboratories under its jurisdiction to enter into relationships with local business as would best fit the particular needs of the Federal facility and the local economy.

Mr. Chairman, we observe that this legislation is revenue-neutral and nonpartisan. This legislation would provide for technology transfer from many Federal laboratories located in and near the districts of most Members of Congress. Approximately 44 such Federal laboratories are located within or near the districts of members of this subcommittee.

We recognize that time will be required in order for technology transfer to occur and new businesses and jobs to be created, so this is indeed a long-range economic development tool, but one that is vital and necessary for many communities throughout this country.

Significant Federal dollars are allocated each year for Federal research. As we have endeavored in our community to maximize cooperation between the private and public sectors, this legislation would enable that spirit to prevail in many communities throughout this country.

Peoria is moving forward and needs this legislation enacted to provide us with a further tool and resource to help negate the effects of the recent and severe economic downturns.

We do urge your wholehearted support and early consideration of H.R. 695.

Again, I appreciate the opportunity to make comments. And as I indicated earlier, if it does please the chairman, I would appreciate it if Mr. Schneider's comments could follow. Thank you, sir.

[The prepared statement of Mr. Neumiller follows:]

PREPARED TESTIMONY OF C. RICHARD NEUMILLER

Mr. Chairman, I appreciate this opportunity to speak to you and the other members of your subcommittee in support of H.R. 695, the "Federal Laboratory Technology Utilization Act of 1985" introduced by our distinguished Congressman, Mr. Robert H. Michel of Peoria, Illinois.

My name is C. Richard Neumiller and I am Director—Legislative & Public Affairs for the Central Illinois Light Company (CILCO) with its headquarters in Peoria, Illinois. My responsibilities include representing the interests of CILCO before members and staffs of the United States Congress and the General Assembly of the State of Illinois. I am a native of the city of Peoria, Illinois and, with the exception of attending college and serving in the United States Army, I have spent my entire life in this community. The economic viability of the Peoria area, therefore, has always been of great concern to me personnally and that concern is shared as well by CILCO.

On May 7, 1985, I completed 12 years of service on the Peoria City Council, having served as both a councilman and more recently as the Mayor of the city of Peoria. My opportunity to serve as Mayor while an employee of CILCO exemplifies the exceptional spirit of cooperation that has existed between the private and public sectors in the city of Peoria over the past several years and reinforces CILCO's deep commitment to the growth and development of the communities it is privileged to serve.

As you have heard and will hear in the testimony of others today from Peoria, our community continues to experience the severe recession that engulfed most of the cities and states of this country in the early 1980's. Because of a worldwide recession, and the strength of the U.S. dollar overseas, our major employer in the Peoria area, the Caterpillar Tractor Co., continues to experience losses on its income statement and has to date found it necessary to layoff approximately one-third of its area working force. Total employment for the Caterpillar Tractor Co. in the Peoria area had been in excess of 33,000. Caterpillar Tractor Co. is also one of CILCO's primary customers.

CILCO is the principle subsidiary of CILCORP, Inc., a new holding company which was created on May 8, 1985 following approvals by the Illinois Commerce Commission and CILCO shareholders. CILCORP was formed to implement a commitment by shareholders of CILCO to aggressively promote economic development within the CILCO service area by eventually making investments in other subsidiary ventures which will result in more jobs and sustained economic growth. CILCO is engaged in the generation, transmission, distribution and sale of electric energy in an area of approximately 3,700 square miles in central and east central Illinois and the purchase, distribution, transportation and sale of natural gas in a similar but not identical service area of approximately 4,500 square miles.

CILCO has always been an active motivator and participant in economic development activities within its service area. As a Peoria City Council member, I was appointed as a co-chairman, along with a representative from the private sector, of the group that developed the recommendation which was adopted by the Peoria Area Association of Commerce that resulted in forming the Economic Development Council for the Peoria Area (EDC) in the early 1980's. EDC is the principal coordinating and promotional agency for economic development in the Peoria area. CILCO's Chief Executive Officer was a charter director of EDC and that tradition continues to this present time. In addition, CILCO is also a contributor to the financial operation of EDC. Early in 1984, CILCO further assigned a Vice President to work full time with the EDC as a loaned executive. That assignment continues in effect as of this date.

Despite the severe economic impact of many changes confronting the community, Peoria has always exhibited an entrepreneural spirit which has resulted in a number of significant improvements. A 65 million dollar civic center complex was constructed and is operating in the downtown central business district. This facility provides the area with an arena capable of seating upwards from 10,000 to 12,000 people for basketball, hockey, rock concerts, etc., a 100,000 square foot exhibition

hall and a 2,000 seat theatre that has one of the best acoustical balances of any facility in the state. All three facilities are interconnected and are ideally located to be mutually supportive of area hotels. Financing for this facility was made possible by the state of Illinois and local taxes on food, beverage, amusement and hotel rooms. No increase in real estate taxes were required and no money was provided by the federal government. As a result of the Civic Center, Peoria's convention business is steadily increasing and is a bright spot for the economy.

As a result of the public sector making this commitment, other significant developments have occurred with regard to new construction and renovation of private sector buildings. Mr. Chairman, what is important for the committee to understand from my remarks is that Peoria has not waited for things to happen, but rather by using and creating resources, necessary improvements have been initiated to accomplish positive growth in the economy. We continue to look for opportunities and resources. H.R. 695 could be such a resource.

Much time and effort has been spent in analyzing strengths within the Peoria area that could translate into future economic activity and jobs. One of our local assets is the Northern Regional Research Center of the United States Department of Agriculture. Economic development analysis done by the community indicated that quite possibly there could be opportunities to work with this Federal laboratory as a result of the research and development done there which could lead to the creation of business and job opportunities.

As efforts proceeded to make contacts with both the Department of Agriculture and the Department of Commerce to determine whether it would be possible to transfer technology from Federal laboratories to the private sector, we became aware of H.R. 695 and the positive impact it could have on the economic development aspects of sharing research. This legislation provides the opportunity to work fully with the federal laboratory in the Peoria area to accomplish a restructuring of our area's economic profile.

We are particularly supportive of the bill's provisions which would enable directors of federal laboratories to enter into cooperative agreements with private business and to enable the laboratories to license such businesses for exclusive use of patents developed within the laboratories. We are also particularly pleased to note that the bill includes an incentive where royalties not only become available to the laboratories themselves, but will be shared with those responsible for the respective research and development. We also applaud the bill's simplicity and directness to bring about a decentralization of these activities which would authorize each agency of the federal government to permit directors of laboratories under its jurisdiction to enter into relationships with local businesses as would best fit the particular needs of that federal facility and the local economy. In addition, Mr. Chairman, we observe that this legislation is revenue neutral and non-partisan. This legislation would provide for technology transfer from many federal laboratories located in and near the districts of most members of Congress. Approximately 44 such federal laboratories are located within or near the districts of members of this subcommittee.

We recognize that time will be required in order for technology transfer to occur and new businesses and jobs to be created. This is indeed a long-range economic development tool; but one that is vital and necessary for many communities throughout this country. Significant federal dollars are allocated each year for federal research. As we have endeavored in our community to maximize cooperation between the private and public sectors, this legislation would enable that spirit to prevail in many communities throughout this country. Peoria is already moving forward and needs this legislation enacted to provide us with a further tool to help negate the effects of the recent, severe economic downturns. We urge your wholehearted support and early consideration of H.R. 695.

Thank you again for this opportunity to appear before you and at the conclusion of our panel's discussion, we would be happy to respond to your questions.

Mr. WALGREN. Well, thank you very much. We certainly appreciate that, and we would be very happy to have Mr. Schneider's comments. We feel that we could go farther and do worse than base much of our perspectives on what happens in Peoria, truthfully. There is a phrase by the same name, I think, about whether things will play there, so you are an important part of this hearing.

You are welcome, Mr. Schneider. Let me simply say that, in the interests of time, there are some limits. But your complete remarks will appear in the record as a matter of course, and feel free to

summarize or otherwise outline and communicate the points you feel you would like to.

STATEMENT OF DELWIN N. SCHNEIDER, VICE PRESIDENT, CENTRAL ILLINOIS LIGHT CO.

Mr. SCHNEIDER. Thank you very much, Mr. Walgren. I'll do that; I recognize that your time is growing short. There are some parts of my presentation that I think are more important, and I'd like in some cases to read those; in other cases, I'd like to talk about some additional comments that may be pertinent.

First of all, passage of H.R. 695 is absolutely necessary for the project that we're working on. The project that I'm referring to involves the formation of a private for-profit corporation that will perform both basic and applied research and development in the field of advanced fermentation. And by applied research and development, I'm talking about the technology transfer process.

The area of advanced fermentation is an area of high technology and it represents a major segment in the application of biotechnology. Advanced fermentation research is a vehicle for the delivery of many products we associate with genetic engineering, as well as the production and utilization of agricultural raw materials. It is proposed that the initial programs are to focus on cellular and subcellular biology, immobilization technology, sensors and process control, and rapid screening technologies, and separation and harvesting technology. The Northern Regional Research Center has particular strengths that can support such research and development in a supplemental manner, thereby allowing for possible leveraging of private industry research dollars. And I might add that that leveraging comes in addition to the leveraging that would occur both from the private industries pooling their dollars for cooperative research, and the dollars that might come outside of that from limited partnership research and development funding or venture capital funding.

And I would like to emphasize the question that was raised by Mr. Boehlert on the importance of the limited partnership and the Tax Act, because it is so important to the provision of funds to do certain kinds of research. It's very risky and very speculative. It's a most important thing.

The members of the proposed organization, which we've called Agricultural Research and Development Corp., ARDC for short, will include major private industries who can utilize the results of such basic research. And here I would comment that we have been in contact with 11 such companies, and have been very encouragingly received. These companies are themselves conducting research into the very kinds of areas that the Peoria Northern Research Center is so skilled at. They are very much interested in considering this kind of an organization. Actually, it is patterned after a company you may have heard of, the Microelectronics Computer Corp. [MCC]. The difference, of course, is that MCC liaisons with the University of Texas at Austin, and we are trying to liaison with the Federal laboratory in Peoria as well as the bio-tech center at the University of Illinois, as well as a newly-created organization, a bio-tech center, with Northern University at deKalb,

the Argonne Laboratory, and, of course, Bradley University is in our own community, which has a very strong biology and chemistry area. This is the network that we have been working with.

ARDC will be a unique new organization that will allow its private industry members to network with the vast Federal laboratory system in order to bring a wide variety of expertise and knowledge to bear on selected high technology research and development projects. It will provide a mechanism to pull basic research through to commercialization. The member companies will include a wide variety of business sectors. We are presently in contact with a number of these companies and have had very encouraging response.

In all, we believe there are 25 to 30 companies interested in specific scientific objectives of ARDC that could gain substantial benefits from being a member.

Our activities in this project to date have been helped and encouraged by the fine support we've received from the local laboratory administration and the top policy support from the Department of Agriculture in Washington. The Department of Agriculture, I believe, sees this organization as a possible new innovative effort to accomplish their desired objective of technology transfer; and without H.R. 695 or its equivalent, this project will not be accomplished. And I would like to comment just a moment about its equivalent at the conclusion of my remarks, as it relates to H.R. 1572.

In order for private industry to link up with Federal labs for extensive cooperative research there must be the ability to be able to establish agreements that can provide for mutual beneficial exchange of services and facilities, including the delineation of rights and ownership to the products created by such efforts.

I think I'd like to conclude—those are my formal remarks, but I think I'd like to add some things.

First of all, we see ARDC as a missing link to the technology transfer process between the on-shelf lab basic research and the commercialization process. There has been a missing link, and it has created a rather passive technology transfer process. And in making these remarks, I make it with respect to the agricultural laboratory only; I'm not referring to the defense or other laboratories. My experience has totally been with the Department of Agriculture.

We have incorporated into ARDC the constraint analysis that Dr. Merrifield referred to as a process for the technology transfer. We've had tremendous support from all of the people in Agriculture and all of the people in Commerce. They really believe that this will work, and if private industry is interested in trying it, they want to see it come through to fruition. And, of course, the legislation that sits here today is in the way of that fruition.

In my discussions with the 11 companies, on several occasions they said, "We can't move forward until H.R. 695 comes to culmination." We have said, "Yes, that's true," but in the process we are continuing to form our organization and reach toward getting there on the assumption that this is going to happen.

And now I'd like to refer a little bit about—well, in conclusion, one thing. Please put yourselves—in considering this legislation, please put yourselves in the position of wearing the moccasins of

industry. I've been there and I've talked to these companies, and I know what their concerns are. They are concerned about proprietariness; they are concerned about sharing their corporate strategy of research and development, and properly so. And yet, they've said to us:

> We, in some instances, can share and can work on a cooperative basis with our own competitors and with universities and with Federal laboratories if it can be structured in such a manner that will allow us to do it and still protect our proprietariness.

And so it's very important that we consider that. It's so important that we also consider the bureaucracy of the system because the industries cannot go into a program that's going to get them bound up. They are in enough difficulty in terms of the very risky research that we're talking about, and if we put obstacles in the way in the bureaucracy issue, it will fall apart.

And so, from those points, I'd like to go on to talk about H.R. 1572. There are two things that primarily worry me about it in my relationship with trying to form this organization.

The first part is that H.R. 1572 talks in terms of centralization, where H.R. 695 talks in terms of decentralization. A great deal of judgment is left to the local laboratory management, the directors of the lab; in the case of Peoria, Dr. Rhoads, a very fine gentleman who has been so cooperative in this. But there needs to be, because of the different kinds of research involved, because of the different problems associated with different kinds of technology transfer, because of different regions and areas and different companies, there needs to be a degree of decentralization left in the hands of local management as opposed to bringing it back to the agency head and setting up quite a long list of requirements and guidelines and objectives and plans. It will stifle the process, in my opinion; that's No. 1.

No. 2 refers to the area in H.R. 1572 with respect to competition and competitive bids, and this is a very, very delicate area. Because if the companies we envision coming together to do joint research on a project would then go to a Federal laboratory, such as Peoria's, and contract with them, or enter into joint agreements with them, that's not going to be subject to bids and subject to saying, "Maybe we ought to try it over here," because if they have to expose themselves to that kind of thing it's not going to happen. So I'm not sure exactly what is meant in terms of the competitiveness of that H.R. 1572, but it's one you must be very careful of or you'll kill it.

Another issue is the multinational companies. Every company we have talked to is multinational, and they have multinational interests. And it's going to be—we're a multinational market. And if the legislation eliminates those kinds of companies or makes it so difficult that they can't be a part of this, then the technology transfer will not take place and we will not form this cooperative effort.

And finally, the point that I would make is manufacturing in U.S. locations. And I recognize that this is, again, a very sensitive area; but again, we are multinational companies and they've got to be able to be free to function in the most profitable manner for themselves. And if we don't—you know, we can have it or we can't have it. If we build barriers we won't get it, and I recognize the

problem you have in protecting the intellectual property of the Federal Government.

I think that concludes my remarks, and I do appreciate the opportunity to talk to you about this. We're very excited about it; we think it can be made to work, and until the flag goes up we're going to keep on trying

[The prepared statement of Mr. Schneider follows:]

PREPARED TESTIMONY OF D.N. SCHNEIDER

My name is Delwin N. Schneider, and I live at 1237 Wonderview Drive, Dunlap, Illinois 61525. I am a Vice President with Central Illinois Light Company. I appreciate the opportunity to tell you about a project that I am working on and to advise you how important passage of House Bill 695 is to that project and to the economic development of our area.

Since February 15, 1984, I have been on special assignment to work with the Economic Development Council of the Greater Peoria area (EDC). The greater Peoria area encompasses three counties with a population of about 300,000 people. EDC is the lead organization for economic development for the entire area and is supported by private industry, a variety of government bodies, and other organizations such as chambers of commerce. EDC was organized in late 1981 in order to respond to the difficult economic conditions within the tri-county area. Statistics vividly reveal how our areas' economy has not rebounded like much of the rest of the nation. we have lost over 20,000 jobs in the last five years, and our unemployment is approximately 17,000 people (approximately 11%).

As you may know, the Peoria area economy has for many years been very heavily oriented toward manufacturing. My assignment with EDC was to consider ways in which we could, as a community, alter our economic profile and hopefully lead to a more stable economy. I'm sure you're also aware that one of our area's strengths is agriculture, and the presence of the Northern Regional Research Center (NRRC), of the U.S. Department of Agriculture, led us to the project that is so closely related to the passage of House Bill 695. The NRRC is a Federal Laboratory and is the second largest Department of Agriculture research facility in the U.S., and we believe offers substantial opportunity for joint industry and government research and development, ultimately leading to the technology transfer concept referred to within the Stevenson-Wydler Act.

The project I'm referring to involves the formation of a private "for profit" corporation that will perform both basic and applied research and development in the field of advanced fermentation. This area of high technology represents a major segment in the application of biotechnology. Advanced fermentation research is the vehicle for the delivery of many products we associate with genetic engineering, as well as the production and utilization of agricultural raw materials. It is proposed that the initial programs are to focus on cellular and subcellular biology, immobilization techology, sensors, process control, and rapid screening technologies and separation and harvesting technologies. The Northern Regional Research Center has particular strengths that could support such research and development in a supplemental manner; thereby allowing for the possible leveraging of private industries' research dollars. The members of our proposed organization, Agricultural Research & Development Corporation (ARDC), will include major private industries who can utilize the results of such basic research. ARDC will be a unique new organization that will allow its private industry members to network with the vast Federal Laboratory system in order to bring a wide variety of expertise and knowledge to bear on selected high technology research and development projects. It will provide a mechanism to pull basic research through to commericalization. The member companies will include a wide variety of business sectors. We are presently in contact with a number of companies and have had very encouraging responses. In all, we believe there are 25-30 companies interested in the specific scientific objectives of ARDC who could gain substantial benefits from being a member.

Our activities in this project to-date have been helped and encouraged by the fine support we received from the local laboratory administration and the top policy support from the Department of Agriculture in Washington. The Department of Agriculture, I believe, sees this organization as a possible new innovative effort to accomplish their desired objective of technology transfer. Without House Bill 695 or its equivalent, however, this project will not be accomplished. In order for private industry to link up with the Federal Laboratories for extensive cooperative research and development, there must be the ability to be able to establish agreements that

can provide for mutually beneficial exchange of services and facilities, including the delineation of rights and ownership to the products created by such efforts.

The Biotechnology Center at the University of Illinois in Urbana/Champaign has been an active supporter and participant in helping to form ARDC. Their vast and fine research capabilities will be a major resource to the new corporation. The Federal Laboratories very badly need the ability to enter into negotiated research arrangements with private industry in the same manner as universities. Without such capability, ARDC will not be formed and technology transfer from within the Federal Laboratory system will continue in its present passive manner. I urge this Committee to think in terms of new horizons and new relationships in order to maintain those technological advantages that our country now has. In order to compete in world markets, there must be new relationships set up between private industry and government, and if we do not, we will lose the economic advantages we have enjoyed.

Again, thank you for the opportunity of discussing our project with you today.

Mr. WALGREN. Well, thank you very much. Those are most interesting comments and perspectives, and I'm sure that you appreciate that in this particular area we certainly want to see things happen; at the same time, there's a special nature of the U.S. tax dollar that's involved in the Federal side of the cooperative pooling, and that puts an even greater obligation on us to make sure that benefits accrue directly to our public. But we certainly appreciate those comments and they're very direct and very useful.

I understand that Dr. Suh has a conflict that is pressing him at this point. I wanted to ask you—wanted to thank you for giving us your time this morning and hearing us through. I apologize for the somewhat unwieldy structure of the panels that has prevented a more clear focus on NSF at this point, but I wanted to give you an opportunity to expand on this idea that the Federal Laboratory Consortium, if it is institutionalized in some form or way, should not be in the NSF. In many ways we've always used the NSF as kind of a cat that we reached back and just threw into the breach to try to make something happen where nothing was happening in Government for a number of reasons. NSF operated with more bipartisan support than many of the other Government efforts, and was a smaller agency and certainly more flexible. This seems to be an area that would respond to very specific kinds of projects and kinds of relationships that we could hope would come from the Federal Laboratory Consortium. I've sort of felt that those things were often only appreciated within, perhaps, a more flexible agency of Government, which I've viewed the NSF as being. And yet, you feel that you can't recommend us putting an institutionalized transfer function within the NSF. Would you like to build on that reservation you have at all?

Dr. SUH. Well, first of all, Mr. Chairman, thank you for allowing me to comment on this.

I think that the issue of what the future role of Federal laboratories ought to be is a very important issue that many of us are spending a great deal of time trying to delineate and to identify critical issues. I think the issues involved here are much more complex, and if we are really serious about promoting technology transfer out of Federal laboratories to the user community, I think there are certain things that perhaps can be done that we are studying.

Simply creating an office where the people who are very far removed from actual innovation of technology and the application of

these technologies may not be as effective as some of us would like to think. That's not to say that I do not value our relationship with the Federal laboratories; in fact, I gave my personal commitment to work with this organization informally, in any way that I can, so that we can benefit through their experience and their wisdom in charting our future course of action in some of these areas.

As a sort of person who has both created technology as well as tried to be the acceptor of new technologies and transfer agent in my former position at M.I.T., my personal opinion is that a lot can be done to utilize the technology developed in these Federal laboratories, but creating organizations like this within NSF is not necessarily the best way of dealing with the problem.

Mr. WALGREN. We've got—when you look at what has been attempted within the National Science Foundation, it's rather interesting. There are several programs that have existed for some period of time in that area. We've just started the engineering research centers, but prior to that we have had the Industry/University Cooperative Research Centers Program which attempted to do just what these bills would attempt to do, with the Federal dollar driving the research component. Whether it's done in the lab or funded by the Federal dollar, it's Federal research at that point. Then we had the research projects, the Industry/University Research Cooperative Research Projects. So, in addition to a center, we could identify a specific project that competed on its merits, so that was funded through the NSF on an industry and university cooperative basis. I wish I knew more about the commercialization value out of that, and what limits there were on the industry return. But then we have the materials research centers, and those are just getting off the ground, but then also the Experimental Program to Stimulate Competitive Research tried to do some things with local governments and academic universities. And then we had the Small Business Innovation Research Program which particularly tried to give some help to small businesses with good ideas that would lead to commercialization.

Dr. Houck had indicated that one of the keys is measuring our success, and I'm wondering whether anybody has tried to measure the success of these kinds of programs in effecting commercialization, compared to what would be other efforts in similar areas, perhaps directly, through the Federal laboratories because there has been some effort going on there. I don't know whether we've done that or not, but certainly the NSF has been our "agency of last resort" to try to do some things that made pragmatic sense to everyone, truthfully.

Looking back over those programs, can you give us an instinctive measure of success that might be comparable to the 17 to 1 ratio that the State organization in Pennsylvania has come up with in its experience?

Dr. SUH. I think I can comment on that rather extensively if you want me to because I happened to, at one point, run one of these I/UC Research Centers established by the National Science Foundation at M.I.T., and that is indeed the longest-existing Cooperative Research Program between M.I.T.—actually, between universities and industry. There is a long track record because the program was established 12 years ago. So we really have done a great deal

to promote technology transfer. If you could bear with me for a few minutes hearing some of these things that they did at MIT, I think that——

Mr. MOSES. May I interrupt for a second? I have a serious plane problem. If we are going to have testimony from the U.S. Conference of Mayors, I must give it soon.

Mr. WALGREN. All right. I was just given a note that Mr. Moses has a plane to catch, and I apologize for that. I wanted to apologize to you for going to Dr. Suh, but Dr. Suh had a conflict, so we're sort of receiving these conflicts sequentially.

I'd be most interested in that testimony. I wonder if you could stay, but I do feel that we really do want to recognize Mr. Moses while he's able to be here, and yet the point that you're about to touch on is one that we ought to have in this record.

Mr. BOEHLERT. Mr. Chairman, could I suggest that we allow the mayor to testify and have Dr. Suh submit his statement for the record? At least we'll have the benefit of his wisdom.

Dr. SUH. Maybe if I just spend 2 minutes, then I can summarize the result of what happened.

Mr. WALGREN. All right. We'll give you 2 minutes and then we'll turn to Dr. Moses. That will give us a good enough record that we, then, should have the obligation of pursuing with witnesses afterwards.

So, Dr. Suh?

Dr. SUH. Well, as the result of a very small investment made by the National Science Foundation at the time, which was about $462,000 over a period of 5 years, the program has raised several million dollars over the course of the past 12 years, maybe close to $10 million from industry to support their research programs in a number of areas related to polymer processing. The outcome of the research resulted in about 30 or more U.S. patents, and in some cases, foreign patents. In some cases—one of the processes, for example, developed by one of our students at MIT resulted in saving NASA somewhere around $10 million to $40 million. That was a master's thesis project that resulted in such a major payback.

In other areas I can cite large numbers of new processes and new products being manufactured by major U.S. corporations. They are being sold, and people are using them. There are numerous examples of such.

The interesting thing about technology transfer is that, in spite of the fact that the technologies that we developed at MIT were paid for by these industrial firms, some of the technologies were not suitable for technology transfer to these firms because we lacked the technology transfer agent, somebody who could take the technology developed at MIT and develop it further for commercial use. And so, after trying a number of different avenues, what we decided to do was establish a number of small companies to act as technology transfer agent. So they raised the money from the venture capitalists or whoever was interested in investing in these, and then these companies took on one of these technologies—each one of these companies took on one of these technologies and then actually went into business to provide that link between the donor of the technology and the acceptor of technology by being a tech-

nology transfer agent. And that, I think, is going rather well at this point.

The issues involved in technology transfer are relatively complex. In order for us to make the Federal laboratories more effective in promoting technology transfer, I think there are some detailed mechanisms one can work out to achieve the goal of utilizing the technology developed in Federal laboratories. Someday I'll be very happy to provide you with my own personal opinions.

Mr. WALGREN. Well, thank you very much. What time is your plane?

Mr. MOSES. At 1:20.

Mr. WALGREN. You're going to make it without trouble. [Laughter.]

But please, let's recognize Mr. Moses at this point and——

Mr. MOSES. It will probably be the shortest report a mayor has ever given. [Laughter.]

STATEMENT OF WINFIELD MOSES, MAYOR, FORT WAYNE, IN, REPRESENTING THE U.S. CONFERENCE OF MAYORS

Mr. MOSES. Thank you for allowing the U.S. Conference of Mayors to participate. This is an important issue for us, and my statements are outlined; you can read them. I will not go through and repeat them.

I would like to succinctly emphasize a couple of particular points.

One, we feel, as mayors, that these bills that are in front of you are absolutely imperative to both improve our city services, to stimulate our economies, and to assure the U.S. worker preeminence in this global competition that we're all participating in.

Since the passage in 1980 of the Stevenson-Wydler Act, city services have been improved dramatically in many locations. The police and fire services, energy conservation, resource recovery, lighting, road maintenance, computer, literacy, to name only a few. Fort Wayne has personally participated in one, called the Argonne Program, which was a district heating program that was very important to us. Your city of Pittsburgh, of course, is well known as being innovative in these areas. In Tucson, AZ, the University of Arizona and Kitt Peak Laboratory assisted the city with improving street lighting. In Weirton, WV, a computer program developed for Navy recruits is used to increase literacy of the citizens. In Miami and St. Louis, a new state-of-the-art firefighting module is being tested. We can go on and on with those examples.

But more importantly, this program will have a real momentum in stimulating the economic development efforts of cities throughout America. In Fort Wayne we have worked with two naval labs a small program; a $2-million program called a CAD/CAM system. We have acronymed it START, summit technology and research transfer. This will train 2,000 people in northeast Indiana alone with over 1,600 students, current employees, and retraining workers. It's the type of effort that communities who have undergone immense restructuring due to the changes in the economy must undertake. Your bills in front of you are important to that.

We need technology transfer because it makes the connection between the Federal labs and local communities. It's the reality link.

It helps to educate local communities about the wealth of untapped resources in our Federal labs, and it helps to educate the Federal labs to the growing needs of local communities. The results are Federal lab assistance in advanced technology training institutes, aid to small startup companies in high technology fields and help in commercial product development. In addition, labs encourage the creation of new businesses through spinoffs started by researchers producing and marketing their own inventions.

We know from our own experiences that new jobs and increased revenues can be generated by technology transfer. One laboratory alone, Sandia National Laboratory in New Mexico, estimates that it has transferred technology to over 500 companies. Technology developed at other labs also has stimulated new businesses in Houston, TX; Los Alamos, NM; Golden, CO; Oak Ridge, TN; Albuquerque, NM; and other cities. In all of these cases, new jobs have been the direct consequence of technology transfer.

There is no doubt that the Stevenson-Wydler Act has played a major role in this success. With the aid of the offices of research and technology applications, known as ORTA's, mandated by the act, cities have a central contact point with the Federal laboratories. Without the ORTA's, identification of the technology needed by a city or a business would be impossible. We feel that the ORTA's serve an invaluable role, but that role needs to be strengthened.

Section XI originally called for the ORTA's to be funded with a 5 percent set-aside from existing research and development budgets. Many waived that; claiming that they were already performing technology transfer functions elsewhere. The reauthorization of the Stevenson-Wydler Act needs to legitimize the funding for technology transfer by including a provision to assure a minimal level of funding for the ORTA's which are the focal point for all technology transfer activities. I think that is the intent of this bill and certainly the intent of Congress as it has been previously expressed that there should be at least two full-time people devoted to technology transfer in every laboratory with a budget over $20 million.

The Federal Laboratory Consortium for Technology Transfer, known as the FLC, has been an invaluable asset to us. It focuses our attention, allows us to know where to go. In my own city it has been used to locate laboratories that had technology appropriate for our new training institute. In others, such as yours, the extensive national networking system was used to locate research with very specialized scientific applications.

We strongly support and urge the committee members to consider institutionalization of the FLC.

In summary, we believe that the bills in front of you have provided the skeleton for an extremely effective national technology transfer system based within Federal research institutions. It is important now that we focus it, that we make it easily accessible, that we fund it in such a fashion that we can be competitive in the global market that we have in front of us. I speak on behalf of all the mayors of the U.S. Conference of Mayors that feel strongly about technology transfer in this very difficult time.

As Congressman Michel said, perhaps the former mayor of Peoria, who is now in private business, made that choice purposely

because these are trying times. These bills that are in front of you are two that could be quite helpful to us, and we would appreciate any assistance you can give.

It has also been conveyed to me that in every instance when I speak with Congresspeople, I should also put in a good word for revenue sharing. [Laughter.]

You know how much time I have. I am happy to answer whatever questions you may have.

[The prepared statement of Mr. Moses follows:]

PREPARED TESTIMONY OF WIN MOSES, JR.

Thank you, Mr. Chairman and committee members for your invitation to discuss technology transfer with you today.

The transfer of technological innovations from the shelves of Federal laboratories to practical applications in business and indsutry across this country has important implications for American cities. We need it to improve city services, stimulate economic growth, create jobs and assure U.S. worker preeminence in the world's competitive economic climate.

Since the passage of the Stevenson-Wydler act in 1980, cities have used Federal technology to improve city police and fire services, energy conservation, lighting, resource recovery, road maintenance, computer systems, literacy programs, to only begin the list.

In my own city, Fort Wayne, Indiana, Argonne National Laboratory assisted us with a district heating project. The year was 1981, and it signaled the beginning of Fort Wayne's association with technology transfer—a relationship that has continued and expanded ever since. With the help of Argonne's extensive computer expertise and data banks, we were able to conduct a professional feasibility study on district heating. This included technical and economic investigations, as well as an environmental impact study. The computer model developed for this project is still in use today as we continually reasses the potential for district heating in our community.

Fort Wayne is only one of many cities assisted by Federal laboratories. In Tucson, Arizona, the University of Arizona and Kitt Peak Laboratory recently assisted the city with improving city lighting. In Weirton, West Virginia, a computer program developed for Navy recruits is being used to increase literacy of Weirton citizens. In Miami and St. Louis, a new state-of-the-art firefighting module is being tested. In a community in northern New Mexico, a prison was redesigned using new security technology developed by a Federal laboratory.

But the impact of Federal laboratory technology transfer only begins with city services. It has found its real momentum in stimulating and enhancing the economic development efforts of many cities. In Fort Wayne, two naval laboratories in Indiana are helping develop a computer aided design and computer aided manufacturing training institute. We call it the start center "summit technology and research transfer." Over the next two to three years the start center's $2 million system will bring CAD/CAM training to 2,000 northeast Indiana businesses. It will train over 1,600 students, current employees, and retrain workers who have been dislocated because of recent manufacturing closings. That's the kind of economic boost that spells increased productivity for existing businesses and heightens our ability to attract new businesses to Fort Wayne. In addition, the start center is a unique public/private, academic partnership unlike any other, a progressive model for technology transfer everywhere.

We need technology transfer because it makes the connection between Federal labs and local communities. It's the reality link. It helps to educate local communities about the wealth of untapped resources in our Federal labs, and it helps to educate the Federal labs to the growing needs of local, communities. The results are Federal laboratory assistance in advanced technology training institutes, aid to small start-up companies in high technology fields, and help in commercial product development. In addition, labs encourage the creation of new businesses through spin-offs started by researchers producing and marketing their own inventions.

We know from our own experiences that new jobs and increased revenue can be generated by technology transfer. One laboratory alone, Sandia National Laboratory in New Mexico, estimates that it has transferred technology to over 500 companies. Technology developed at other labs also has stimulated new business in Houston, Texas; Los Alamos, New Mexico; Golden, Colorado; Oak Ridge, Tennessee; Albuquer-

que, New Mexico; and other cities. In all of these cases new jobs have been the direct consequence of technology transfer.

There is no doubt that the Stevenson-Wydler Act has played a major role in this success. With the aid of the offices of research and technology application, known as ORTA's, mandated by the act, cities have a central contact point with the Federal laboratory. Without the ORTA's, identification of the technology needed by a city or a business would be impossible. We feel that the ORTA's serve an invaluable role, but that role needs to be strengthened.

Section 11 of the Stevenson-Wydler Act originally called for the ORTA's to be funded from a 5 percent set-aside from existing research and development budgets. Our understanding is that the agencies waived this requirement claiming that they were already performing technology transfer functions elsewhere. We strongly believe that the reauthorization of Stevenson-Wydler should include a provision that assures a minimal level of funding for the ORTA offices. Some form of assured funding is necessary because cities and businesses must have a focal point of contact in the laboratory. Moreover, assured funding of the ORTA offices will allow them to undertake more active technology transfer functions that go beyond mere information dissemination. We also believe that ORTA's should be strengthened by requiring them to have at least two full-time people devoted to technology transfer, in every laboratory with a budget over $20 million.

The Federal Laboratory Consortium for Technology Transfer, known as the FLC, in particular, has been an invaluable asset to technology transfer activities. Without it, some of the recent technology transfer activities would not have taken place. A technology transfer-economic development project, currently being conducted by the U.S. Conference of Mayors, has used the FLC extensively to locate Federal laboratories with specific types of technology; to channel cities to the most appropriate laboratory and resource people; and to provide general information and guidance on technology transfer resources. In my own city of Fort Wayne, the FLC was used to locate laboratories that had technology appropriate for our new training institute. In other cities, such as Pittsburgh, the FLC's extensive national networking system was used to locate research with very specialized scientific applications.

We strongly support and urge the committee members to consider institutionalization of the FLC, and we support funding the FLC from existing Federal agency research and development budgets. The Federal Laboratory Consortium for Technology transfer requires institutionalization and funding, to conduct active networking and outreach activities that serve all the cities and business who need it.

In summary, we believe that the Stevenson-Wydler Act has provided the skeleton for an extremely effective national technology transfer system based within our Federal research institutions. It has stimulated technology transfer activities that have directly benefited city services; and have increased jobs and city revenues. But now we need to strengthen both the ORTA structure and the FLC to really make the system work. We believe that this national technology transfer can work better only when certain basic staffing and minimal funding needs of the ORTA's are met; and when the FLC is institutionalized and funded to provide these ORTA's with an effective national network. In the face of the increased foreign competition to produce high technology faster and cheaper, and in light of the potential impact on our cities from lost employment and revenues, we should do everything in our power to promote technology transfer activities to the public and private sectors.

Mr. WALGREN. Well, thank you very much.

The Chair would recognize Mr. Boehlert.

Mr. BOEHLERT. What is your fiscal year in Fort Wayne?

Mr. MOSES. It's the calendar year.

Mr. BOEHLERT. Calendar year? You'll be OK on revenue sharing.

Mr. MOSES. Well, what you mean is that we'll be able to ease into it. Now, that's different than OK. [Laughter.]

Mr. BOEHLERT. Here's the frustration that we all share. We're dealing with a very vital, important topic today. You've all presented excellent testimony. We all have to get your plane, Mr. Mayor; I thank you and the Conference for your excellent statement. Dr. Houck—quite comprehensive, and we've had the advantage of it—former mayor and now a man in the real world, we thank you for your statement, and I'm interested in what both Fort Wayne and

Peoria are doing. Don't you wish in Peoria that you had the money and resources that they have at MCC down in Texas?

Mr. MOSES. Yes, sir.

Mr. BOEHLERT. I think it's mind boggling.

I think you've all done an excellent job. We're sorry that the hearing went on as long as it did, but it's because you are as interesting as you are.

Thank you all very much.

Mr. WALGREN. And with that, we'll suspend until tomorrow at 9:30. Thank you very much on behalf of the committee.

[Whereupon, at 12:29 p.m., the subcommittee recessed, to reconvene at 9:30 a.m. Wednesday, May 22, 1985.]

TECHNOLOGY TRANSFER

WEDNESDAY, MAY 22, 1985

HOUSE OF REPRESENTATIVES,
COMMITTEE ON SCIENCE AND TECHNOLOGY,
SUBCOMMITTEE ON SCIENCE, RESEARCH AND TECHNOLOGY,
Washington, DC.

The subcommittee met pursuant to call at 9:30 a.m. in room 2325, Rayburn House Office Building, Hon. Doug Walgren (chairman of the subcommittee) presiding.

Mr. BROWN [presiding]. The subcommittee will come to order.

In an effort to expedite the proceedings of the hearing, I am going to begin the process and invite the first panel to take their seats at the table. I may even read the opening statement of the chairman, Mr. Walgren and in other ways get rid of some preliminaries in order that we may be able to get off to a running start as quickly as we can.

"Today is the second of 2 days of hearings on the state of technology transfer from the Federal Government to the private sector and on legislative initiatives which have been proposed to address problems in this area. Yesterday, we heard from representatives of State and local governments, businesses and nonprofits actually involved in technology development, and those Federal Government entities involved in Government policy regarding technology and innovation. Today, we will hear from distinguished representatives of the Government laboratories, Federal agencies with large research programs, the university community, and the professional societies.

We would like to continue to probe the general issues surrounding technology transfer, as well as to learn more about the merits of the bills, H.R. 1572 and H.R. 695. We understand that the administration has not taken a position on either bill and we are not looking for one at this point. We are pleased that the administration, like the committee, is not committing itself prematurely to a specific set of legislative ideas while we are still in the information gathering and information sorting stage of the legislative process.

This topic is too important to our national economic well-being to rush through legislation which might have to be changed later, in light of a more complete understanding of the problem involved. Therefore, we welcome all our witnesses to share their experience with us and to give their views on how we can increase the likelihood of commercialization of the best ideas generated from the tens of billions of dollars spent each year on Federal research. We welcome your ideas, encourage you to be open, and pledge to do our

best to translate your cumulative wisdom into meaningful legislation."

Mr. BROWN. Those are the immortal words of our chairman, Mr. Walgren, and I can only second them. We have been pursuing this general subject of how to improve the processes which stem from science and technology and extend through to the development of new products and processes to improve the life of our community. We have been doing that for a number of years in this committee, and I don't think we have come up with any magic answers to the problems yet.

Let me welcome the three of you who are here and Dr. Drew will be here shortly I understand, and ask that you start with Dr. Gray.

Dr. Gray, I have had the pleasure of meeting you on one or two occasions and know what a wonderful institution you preside over. We are very fortunate to have you here this morning to discuss these problems, and look forward to hearing your testimony.

STATEMENTS OF PAUL E. GRAY, PH.D., PRESIDENT, MASSACHUSETTS INSTITUTE OF TECHNOLOGY, CAMBRIDGE, MA; ROBERT P. STROMBERG, TECHNOLOGY TRANSFER OFFICER, SANDIA NATIONAL LABORATORIES, ALBUQUERQUE, NM; AND EUGENE E. STARK, JR., PH.D., CHAIRMAN, FEDERAL LABORATORY CONSORTIUM, LOS ALAMOS NATIONAL LABORATORY, LOS ALAMOS, NM

Mr. GRAY. Thank you, Mr. Chairman.

I am Paul E. Gray, president of the Massachusetts Institute of Technology. I am pleased to have this opportunity to share with you, in the context of your legislative concerns, my observations on technology transfer, and, specifically, on some ways to help bring the results of federally funded research to the American commercial marketplace.

In these comments, I shall draw extensively on the M.I.T. experience in university-industry relations, but I believe that much of that experience will be relevant to the basic concerns of the Stevenson-Wydler Technology Innovation Act and to the question of the transfer of technology from Federal laboratories to commercial application for the benefit of the public.

The university has been traditionally one of the primary sources of creative thought in society. Another newer locus is found in the Federal laboratories. As all of us in the field of technology are aware, creative thought does not in itself ensure the transfer of discoveries and inventions to society in a meaningful way. It is therefore essential that we develop cooperative activities between basic research institutions and industry, activities that will assure both the rapid and effective transfer of new technologies, the relevance of our educational programs, and the necessary financial support of the underlying research.

My experience is that the best way to transfer technology is through individuals, people meeting, talking, and working with each other. Federal centers and boards chartered to program technology transfer probably would not have a major impact. On the other hand, Federal programs to create local environments at universities and at national laboratories where interactions can take

place would, in my view, be the most significant contribution Congress could make to the cause of technology transfer.

The National Science Foundation is undertaking such efforts through its recently inaugurated university/industry cooperation projects. NSF is also providing support for the establishment of university engineering research centers devoted to specific areas of technology—at M.I.T., it is applied biotechnology—where programs will, by design, involve basic research workers and industry representatives working together to streamline the identification and exploitation of technical advances derived from basic research and apply it to the marketplace.

The innovation that begins in a basic research laboratory usually must be nurtured and developed before it can lead to commercially important products or services. To speed this process, business and universities, and perhaps Federal laboratories must work together and communicate effectively with one another at the personal level. Let me outline some of the ways in which these interactions work at M.I.T. They are many and varied.

More than 300 companies are members of our Industrial Liaison Program providing the university with general funds each year and receiving in exchange a window through which to view the developments of technological research in fields of interest to them, through publications, through symposia, campus visits and faculty and staff visits to their plants. Groups of companies of like interest have come together at M.I.T. to form collegia or consortia to support and interact with research in fields of mutual interest, ranging from construction and manufacturing technology to polymer processing.

It seems to me that these modes are adaptable in some measure to Federal laboratories as well. Patent licensing is another avenue for encouraging the application of research. At M.I.T. our most common practice is to award licenses to use our patents on a nonexclusive basis unless it is our independent judgment that the only practicable way to transfer the technology involved is through an exclusive license.

In the distribution of royalties, we share the income among the inventor, his or her laboratory and the institution. Some of the larger research agreements between M.I.T. and industry may be of interest to this committee. Several years ago, we entered into an agreement with the Exxon Research and Engineering Corp., which is providing M.I.T. with $8 million over a 10-year period for research in fossil fuel conversion and utilization.

More recently we entered into an agreement with W.R. Grace & Co. providing for up to $7 million in support for research in biotechnology over a 5-year period. In both cases, proposals for specific research projects are generated by individual professors or groups of professors. Awards are made by selection committees with equal representation from the sponsor and the university.

Sponsors receive advance notice of planned publications to guard against inadvertent disclosure of proprietary information. But otherwise sponsors have no control over the open publication of research results. All patents that may result from the research belong to the university. The university does agree to allow the sponsor to use the patents without royalties, but the university re-

serves the right to license others to the same patents including the sponsor's competitors.

I do not mean to suggest in these remarks that good working relationships are barrier-free. There are, I believe, four principal barriers to product university/industry linkages. First, is the difficulty of designing a collaborative research program that fits the university's unique educational obligations toward its students and the industry partner's concern for useful knowledge to be applied toward development of products, processes, and services. Industry inevitably seeks, properly seeks a competitive advantage, and this must be recognized from the beginning.

Second is how to organize a research program that accommodates the time constants of universities, where graduate students intimately involved with the research are following programs of study that span several years, and industry's time constants which tend to be much shorter and oriented to fast-moving markets.

Third, is how to protect proprietary information supplied by a sponsor to facilitate a research program, so university scientists do not unknowingly try to re-invent existing technology, while meeting the statutory and ethical traditional requirements that university research serve a broad public good and be conducted in an atmosphere of openness and free exchange.

Fourth relates to patents and copyrights, how to determine methods of licensing that will promote the progress of science and technology, that will assure that discoveries and inventions are used in ways that benefit the public, and that provide recognition for university inventors and financial support for their universities.

The M.I.T. experience suggests, I believe, that with careful planning, each of these issues can be resolved and the needs of each research partner and the public can be met without conflict or compromise.

It is perhaps noteworthy that industrially sponsored research has been the most rapidly growing component of the research enterprise at M.I.T., for the last 5 or 6 years. And industrial sponsorship now counts for nearly 15 percent of the sponsored research budget.

The most obvious national advantage to the fostering of wider university-industry relations, or relations between Federal laboratories and industry is clearly the quicker and more effective application of the fruits of research to industrial operations. We need to facilitate and accelerate that process. In recent years, the Japanese have not often seized from us positions of scientific leadership; but they have often succeeded in superior implementation. Thus stronger relationships that bridge between U.S. industry and basic research can be seen as matters of national interest to be encouraged and fostered by Congress.

There is an intellectual incentive, also—one not often mentioned in discussions of university-industry relations. Our associate provost and vice president for research, Dr. Kenneth A. Smith, believes this benefit accrues to both the university and industry and is perhaps the most important incentive of all for the fostering of these relationships. Speaking of the Nation as a whole, Professor Smith has written:

> To a first approximation, there has not been a sufficient industry presence on university campuses. Students and faculty have had little exposure to industrial prob-

lems or to industrial motivations. Thus they have tended to adopt the values of their own environment, which is the university, and of their sponsor, which has largely been the Federal Government. This being the case, the universities simply have not been enriched by strong interactions with industry, despite the fact that most students seek employment in industry and despite the fact that industry is, after all, the agent through which the benefits of science and technology are usually transferred to the public.

My final observation is to stress that the key to stimulating innovation is to concentrate on creating environments where interactions are fostered, favored and encouraged, and to avoid trying to create institutional frameworks that seek to affect human behavior by means of edict. The later simply won't happen. Rather, you might explore ways in which Federal agencies that have long experience with the Nation's basic research enterprise can promote industry interaction.

This means aggressive programs within universities and Federal laboratories to enlist industrial cooperation and interaction, perhaps even the establishment of offices within universities and Federal laboratories specifically organized to develop industrial liaison. Agencies and universities, likewise, might put forth organized efforts to market patents that grow out of basic research and, in that manner, develop contact with industry.

Patent marketing is, at best, a very difficult task. Universities and Federal laboratories also need to find ways to communicate directly with corporate chief executive officers relating to specific high technology areas that are just taking form at the basic research level. I cannot emphasize enough, based on our experiences at M.I.T., the need to involve basic research organizations with chief executive officers of industrial corporations.

Finally, it is my belief that U.S. basic research ought to focus its competitive energies in all areas of technology on leap frogging over the technical achievements of our foreign competitors and not simply try to out-improve them. I am persuaded by our long experience at M.I.T. that, when the industrial dimension is added to basic research organizations, the leap frogging effect will emerge spontaneously at the person-to-person level.

In the final analysis, that's the level where technology transfer really happens. Thank you very much.

[The statement of Mr. Gray follows:]

PAUL E. GRAY STATEMENT, May 22, 1985

Mr. Chairman, members of the Committee:

I am Paul E. Gray, President of the Massachusetts Institute of Technology. I was formerly Professor of Electrical Engineering at M.I.T. and, before becoming President in July of 1980, I served successively as Dean of Engineering and Chancellor. In addition, I serve as a director of several technology-dependent corporations.

I am pleased to have this opportunity to share with you, in the context of your legislative concerns, my observations on technology transfer, and, specifically, on some ways to help bring the results of Federally-funded research to the American commercial marketplace.

In these comments, I shall draw extensively on the M.I.T. experience in university-industry relations, but I believe that much of that experience will be relevant to the basic concerns of the Stevenson-Wydler Technology Innovation Act and to the question of the transfer of technology from Federal laboratories to commercial application for the benefit of the public.

I have appeared on previous occasions before various Committees of Congress, including this one, in support of legislative initiatives that have enriched and expanded university-industry interactions as a primary mechanism for the transfer of the fruits of research to the marketplace. I am happy in doing so again this morning to reiterate what has been my consistent point of departure, and that is this:

PAUL E. GRAY STATEMENT, May 22, 1985

The university has been traditionally one of the primary sources of creative thought in society. Another newer locus is found in the Federal laboratories. As all of us in the field of technology are aware, however, creative thought does not in itself ensure the transfer of discoveries and inventions to society in a meaningful way. It is therefore essential that we develop cooperative activities between basic research institutions and industry that will assure both the rapid and effective transfer of new technologies, the relevance of our educational programs, and the necessary financial support of the underlying research.

With the passing of time, my convictions have become only stronger. Over the past few years, intensified international competition and the increasing pace of technical developments in many fields have brought about a heightened interest on the part of industry in university and other basic research activities. Experience has shown that these interactions not only strengthen the industries involved, but they also enrich both the nation's research effort and, on our campuses, the quality of our teaching.

My experience is that the transfers of technology we all seek occur spontaneously at the level of individuals, at the level of people meeting, talking and working with people. Federal centers and boards chartered to "program" technology transfer, as if by magic, probably would not have a major impact. Federal programs to create local environments--at universities, at national laboratories--where interactions can take place would, in my view, be the most significant contribution Congress could make to the cause of technology transfer.

PAUL E. GRAY STATEMENT, May 22, 1985

The NSF, as you know, is undertaking such efforts through its recently-inaugurated University/Industry cooperation projects. NSF is also providing support for the establishment of university engineering research centers devoted to specific areas of technology--at M.I.T. it is applied biotechnology--where programs will, by design, involve both representatives from relevant companies and university personnel.

The newer NSF programs evolved, in part, from an earlier NSF-supported experiment, including one conducted at M.I.T. In the early 1970s, with NSF support, we established at MIT a university-industry program of research in polymer processing--plastics, if you will. The companies that joined with us in that effort became enthusiastic about the benefits they derived from the association--so much so that the private sector, as it had been hoped, took over the financing within a few years, expanded it by nearly an order of magnitude, and the NSF support was terminated.

In other words, it has been shown increasingly that personal ties between basic research workers and industry representatives will streamline the identification and exploitation of technical advances derived from basic research and applied to the marketplace. The innovation that begins in a basic research laboratory usually must be nurtured and developed before it can lead to commercially-important products or services. To speed this process, business and universities--and, perhaps, Federal laboratories--must work together and communicate effectively with one another at the personal level.

Let me say that all this industry-university action, by the way, has not, for some reason, won unqualified popular approval in this country, judging by the press. Despite mounting evidence of the value

of university-industry cooperation, there remains within our society--and possibly within the Congress--the vague suspicion that industrial interactions somehow taint the purity of scholarship, that basic research is somehow corrupted by association with business.

In my view, such mistrust as may exist probably stems from the belief that the needs of industrial partners for propreitary secrecy and other competitive advantages necessarily run counter to and may undermine scholarly traditions of open scientific exchange. The university I serve has probably had as much experience with industrial cooperation over as long a period of time as any major institution in the United States. From that vantage, I can tell you that if university-industry interactions are negotiated carefully, thoughtfully and in good faith, the interests of the public, industry and academia can be--and are being--protected.

Dangers do exist, and our experiences at M.I.T. have shown that the incentives for both parties must, from the outset of negotiations, be clarified and assessed, for they are the key to the evolution of a strong and healthy partnership. That mutually beneficial and protective agreements can be arrived at is now clear.

Let me outline for you in a broad way some of the history and some of the dimensions of university-industry relationships at M.I.T. Our institute was chartered in 1861 expressly for the purpose of advancing the useful industrial arts and our cooperation with industry goes well back into the 19th Century. In 1882, the year that M.I.T. began the first curriculum in electrical engineering, New England's first electric street lights were turned on in Lynn, Massachusetts, powered by a dynamo built by an M.I.T. faculty member. In 1895, the

time-temperature tables for the preparation and canning of various foods resulted from a bench-level research partnership between an M.I.T. professor and the principal officer of a leading food company, thus transforming the canning of food from an empirical and often frightenly dangerous art into a technology based on clear scientific findings. A Research Laboratory for Applied Chemistry was established at M.I.T. in 1905 with industrial cooperation and that effort eventually led to the field of endeavor we now call chemical engineering. And so on.

At present, our interactions with industry are many and varied. More than 300 companies are members of our Industrial Liaison Program, providing the university with general funds each year and receiving, in exchange, a window through which to view the development of technological research in fields of interest to them--through publications, symposia and campus visits. Groups of companies of like interests have come together at M.I.T. to form nearly a dozen collegia to support and interact with research in fields such as communications, construction, manufacturing technology, chemistry, materials, management and economics. Still others have been drawn together as consortia more closely focused on such specific lines of research as, for example, polymer processing and the processing of ceramic powders. It seems to me these modes are adaptable in some measure to our Federal laboratories.

Patent licensing is still another avenue for encouraging the application of research. At MIT, our most common practice is to award licenses to use our patents on a non-exclusive basis, unless it is our independent judgment that the only practicable way to transfer the technology involved is through an exclusive patent arrangement. In

the distribution of royalties, we share the income among the inventor, his laboratory, and the Institute.

Some of the larger research agreements between M.I.T. and industry may be of interest to you. Several years ago we entered into a agreement with the Exxon Research and Engineering Corp. that is providing M.I.T. with $8 million over a 10-year period for research in high temperature reactions associated with fossil-fuel conversion and utilization. More recently, we entered into an agreement with W.R. Grace & Co. providing for up to $7 million in support for research in biotechnology over a five-year period. In both cases, proposals for specific research projects are generated by individual professors or groups of professors. Awards are made by selection committees with equal representation from the sponsor and the university. All research is open. Students are protected from dealing with proprietary information. Sponsors receive advance notice of planned publications to guard against inadvertent disclosure of proprietary information, but otherwise sponsors have no control over the open publication of research results. All patents that may result from the research belong to the university. The university does agree to allow the sponsor to use the patents without paying royalties, but the university reserves the right to license others to use the same patents, including the sponsor's competitors.

I do not mean to suggest, in these remarks, that good working relationships are barrier-free. There are, I believe, four primary barriers to productive university-industry linkages. First is the difficulty of designing a collaborative research program that fits the university's unique educational obligations toward its students and

the industry partner's concern for useful knowledge to be applied toward development of products, processes and services. Second is how to organize a research program that accommodates the time constants of universities, where graduate students intimately involved with the research are following programs of study that span several years, and industry's time constants which tend to be oriented to fast-moving markets. Third, is how to protect proprietary information supplied by a sponsor to facilitate a research program--so university scientists do not unknowingly try to re-invent existing technology--while meeting the statutory and ethical requirements that university research serve a broad public good and be conducted in an atmosphere of openness and free exchange. Fourth relates to patents and copyrights--how to determine methods of licensing that will promote the progress of science and technology, that will assure that discoveries and inventions are used in ways that benefit the public, and that provide recognition for university inventors and financial support for their universities.

The M.I.T. experience suggests, I believe, that with careful planning, each of these issues can be resolved and the needs of each research partner--and the public--can be met without conflict or compromise.

The most obvious national advantage to the fostering of wider university-industry relations--or relations between Federal laboratories and industry--is clearly the quicker and more effective application of the fruits of research to industrial operations. We need to facilitate and accelerate that process. In recent years, the

Japanese have not often seized from us positions of scientific leadership: but they have often succeeded in superior implementation. Thus stronger relationships that bridge between U.S. industry and basic research can be seen as matters of national interest to be encouraged and fostered by Congress.

There is an intellectual incentive, also--one not often mentioned in discussions of university-industry relations. Our Associate Provost and Vice President for Research, Dr. Kenneth A. Smith, believes this benefit accrues to both the university and industry and is perhaps the most important incentive of all for the fostering of these relationships. Speaking of the nation as a whole, Professor Smith has written:

"To a first approximation, there has not been [a sufficient] industry presence on university campuses for . . . student and faculty have had little exposure to industrial problems or to industrial motivations. Thus they have tended to adopt the values of their environment, which is the university, and of their sponsor, which has largely been the Federal government. This being the case, the universities simply have not been enriched by strong interactions with industry, despite the fact that most students seek employment in industry and despite the fact that industry is, after all, the agent through which the benefits of science and technology are usually transferred to the public."

In other words, linkage with industry can give our basic research programs new perspectives. While universities, and many Federal laboratories as well, continue to move in directions governed primarily by the shifting frontiers of knowledge and by the instincts

and insights of their faculties and staff scientists, the universities and laboratories benefit from the perspectives that can be gained from close associations with industry. Conversely, the benefit pays back to industry in the form of research programs more closely geared to industrial interests and, in the case of universities in the form of graduates better prepared to meet industrial needs when they take up industrial employment, not to mention the intellectual impacts on the industry representatives themselves.

My final observation is to stress that the key to stimulating innovation is to concentrate on creating environments where interactions are fostered, favored and encouraged, and to avoid trying to create institutional frameworks that seek to affect human behavior by means of edict. The latter won't happen.

Rather, you might explore ways in which Federal agencies that have long experience with the nation's basic research enterprise can promote industry interaction.

This means aggressive programs within universities and federal laboratories to enlist industrial cooperation and interaction, perhaps even the establishment of offices within universities and Federal laboratories specifically organized to develop industrial liaison. Agencies and universities, likewise, might put forth organized efforts to market patents that grow out of basic research and, in that manner, develop contact with industry. Universities and Federal laboratories also need to find ways to communicate directly with corporate chief executive officers relating to specific high technology areas that are just taking form at the basic research level. I cannot emphasize enough, based on our experiences at M.I.T., the need to involve basic research organizations with chief executive officers.

PAUL E. GRAY STATEMENT, May 22, 1985

Finally, it is my belief that U.S. basic research ought to focus its competitive energies in all areas of technology on "leap frogging" over the technical achievements of our foreign competitors and not simply try to "out improve" them. I am persuaded by our long experience at M.I.T. that, when the industrial dimension is added to basic research organizations, the "leap frogging" effect will emerge spontaneously at the person-to-person level.

In the final analysis, that's the level where transfer really happens.

Thank you very much.

Mr. WALGREN. Thank you, Dr. Gray.

Let's turn to Dr. Stromberg, and I want to give you apologies of Manuel Lujan who had wanted to be here to give you a specific introduction. He may yet arrive momentarily, but we ought to go ahead anyway, and know that you are welcome.

Mr. STROMBERG. Thank you.

I would like to first make sure people recognize on page 3 there is a typo in my remarks. Somehow the acronym in about the first paragraph where it says, "GOCO" really should be "GOGO" Government-owned/Government-operated. It slipped through. Sorry about that.

Mr. WALGREN. We will catch it.

Mr. STROMBERG. My name is Bob Stromberg. I am from Sandia National Labs in Albuquerque, one of the larger labs in the country and in the Department of Energy. We are a contract laboratory managed by AT&T Technologies, Inc., set up at the request of President Truman many years ago when he asked that there be a laboratory managed for the Government like an industrial laboratory. And that was our start.

Our primary responsibility to the country is the engineering development on nuclear weapons. I had been technical supervisor for many years, and then a few years ago was asked to take over the job of technology transfer at the laboratory, and was startled to discover when I began looking, that even though I knew of many examples, through my friends, when I did a very routine and careful analysis of what was happening in our laboratory, I found examples just like a rabbit behind every bush.

I now have a very accurately confirmed record over the last 4 years of some 530 users of technology representing 161 technologies. So I find that there is a tremendous outflow from our laboratory to American industry. I am going to try and describe to you what I have learned as a result of studying in detail those 530 examples. It seems as if the rate will probably continue with somewhat of a decrease, because our laboratory, during the energy crisis

years, had reached almost 25 percent energy program work and we are now down—the percentage is decreasing.

My talk will be in three sections. I am not going to read the comments I submitted to you. I am going to talk about a few technical points first, then talk about the motivations that I think apply to tech transfer, and then very clearly offer my support to the efforts to somehow institutionalize the Federal Lab Consortium.

I think when I look through the technology transfer from our lab, it seems to me that the real criteria that determines the amount of flow of technology from Federal laboratories is the motivation of the individual people. Are they really motivated to commercialize? Are they motivated to transfer, or are they really motivated to see that both processes go on simultaneously. Because if one starts out to commercialize something, he tries to generate an advantage for one particular group over others in order to allow for the development and marketing to take place.

There is an effort, then, to restrict information to that favored group, so they can carry out a major development effort and proceed with commercialization. One example at our lab recently is a new device, an insulin pump, which can be implanted under the skin. Believe it or not, it uses a part directly out of nuclear weapons to actuate the pump.

An exclusive arrangement was made with one company after giving many companies an opportunity to submit proposals. On the other hand, if you are trying to commercialize something where you are really just doing an incremental change in an existing industry, then giving it to all competent groups makes good sense. This will bring up the standards of American competitive industry compared to other countries. We have a couple of examples of that.

One is a case of a drill bit that was designed by our people using some polycrystalline diamond cutters. That was given to all comers, and as a result now is drilling, we have been told, about one-third of all the footage in the wells throughout the world. And it is only about a 6-year-old development. Some 15 American companies are now the predominant designers, builders and sellers of that bit.

Another example is a new glass used in batteries. It was put into weapon batteries, but is now spreading through the battery field for long-life batteries for medical purposes. And again, by passing that technology to all the glass to metal seal companies in the United States at one ceramic society meeting, that technology spread to all those competitors in just a matter of about a year.

I think the motivation has to be clear as to really what one is setting out to do.

My first point, has to do with a difficulty that we run into that is covered rather extensively in my testimony. It is clear that the purpose as stated in the Stevenson-Wydler Act is that there be preferential treatment given to American industry in order to promote American competitiveness.

There are really two serious problems with that. When the phone rings and I talk to someone who says he is from an American company, I don't have the resources to determine just exactly what that company's practices are. They may very well have an influence on positive trade balance in this country. They may have

moved almost all their operations offshore and in fact be a very large detriment to the American trade balance. And I don't have access to that information.

Also it is really not clear from the way in which the Stevenson-Wydler law was written exactly how one might qualify were he to have that information. Which companies should be given this favored treatment? As you will find in the testimony, when I was in Japan about a year ago I had difficulty trying to explain to Japanese entrepreneurs what would be the conditions under which they would have free access to our lab.

I was up against the difficulty of trying to interpret what had been stated in 96-480. It is difficult to be exact—and those people wanted direct and very exact definitions of what was the point at which we would open our doors in the same way that we would to a purely domestic company. I think that is a serious policy issue that I would suggest to you for further thought as you work on any changes in that bill.

Also 96-480 specifies the steps to take in transferring technology and those of us, I think, that work in the area of technology transfer recognize many times there is a tremendous difference in the appropriate way to transfer one technology compared to another. I think that publication of application assessments as covered in 96-480, is too strongly put. There are so many other better ways for some technologies to be transferred, that I would suggest some review of that point.

As I mentioned, one of our people speaking at a ceramics society meeting in one case may be the appropriate way that will completely transfer the technology, because all of the people who deal in that technology will be present and the technology availability will be made known in an instant. In other cases like a new software project we did that allows people to build a part on a screen before they build it in metal, it is appropriate that it be published in the way that was mentioned. And we find that giving our information to the trade magazines, we get a much wider circulation.

So I would suggest to you that there are many other ways, and that the emphasis of that bill may really be pointed heavily toward putting a requirement on us to follow a particular line of practice which in many cases isn't the correct way.

I would like to make a point that I was just talking with Dr. Stark before the meeting. From our perspective, I think our best estimate today is that there are probably 30 or 35 full-time people at the Federal labs involved in tech transfer. That is about where we see it, and we don't have an accurate count. But that may give you a feeling toward why we ask that you help us to see to it that more laboratories, establish full-time people so that the people who deal in tech transfer don't have many other duties that keep them from, working with that problem.

Mr. WALGREN. Thirty-five nationwide?

Mr. STROMBERG. Yes, sir. That is an estimate. I think you will find others would agree. I know Gene and I agree that that is our best estimate of full-time. So I think that may give you some perspective.

A hundred plus people come to our Federal Lab Consortium meetings. Many of those people have many other duties besides the

tech transfer duties that they represent when they come to those meetings.

I would also want to make certain, that I point out to you one place that has worked extremely well. In the nuclear weapons program, there exists a series of integrated contractors that have been kept together as a group and given arrangements by which they have very easy free access to one another. That has allowed that group, I think, to keep those projects moving faster than they would, should they be given complete freedom for competitive action on their own.

I think it is probably necessary to continue some kind of restriction on those commercial contractors such that they do not ever generate a position of competition with one another within that group. It would probably slow down that group's extremely good and easy cooperation that has been part of that project for many years.

Now the other point. The large record at our lab. I tried to figure out what causes it, and why I have such a large computerized base of examples, I think our employees find themselves in a very clean position without any conflicts and it makes it very easy for them. Once our technologies have been looked at from the point of view of patents and classification, and once they have been reviewed by upper management from an appropriate point of view, they are totally free without any restrictions to transmit. As a matter of fact, it is part of their job to see to it, and it is the spirit of the lab to see to it that that information is transferred as a part of the job of the laboratory employee. As a matter of fact, their promotions and their reputation at the laboratory are determined partly on the basis of how well they do the tech transfer job.

I see that every time we come in May to merit review. I hear from supervisors and realize they are considering how well people saw to it that their information was transferred, in order to decide which people receive raises. So I think this probably is the reason that tech transfer has really gone well. I think that's why I would comment in favor of a process to give some type of a merit reward, or if not a merit reward, the patent royalty awards that are being prescribed for the Government employee. It is much more difficult, as we heard yesterday, from Mr. Michel, to have a merit system operating to give some type of royalty award as a legitimate incentive, as well as some arrangement by which the Government labs can set up joint arrangements with industry.

Those of us in the contract labs find that that is done all the time. We have a large number for instance, this past year we had over 9,000 large contractual arrangements with industry just from our laboratory alone. The interactions are very numerous and very continuous. And the joint arrangements are nowhere near that amount, but we have a number of arrangements where we are jointly profiting from measurements on proprietary materials that are used in our program. And we have joint arrangements with universities all the way from MIT to Stanford and in between.

The last point that I would like to make is as follows: I joined the Federal Lab Consortium, which is simply an ad hoc group of those of us who represent the tech transfer process at Federal labs, some 3 years ago. I am very pleased to report that I think it is a very

obvious and good solution to the problem of pulling together the technologies that exist at all the labs. As you will see in the notes, I had the experience just a week ago Friday of having a phone call from a man at LTV in Dallas who was desperate and wanting to know if we could help him find a downed pilot somewhere in Oklahoma.

Our lab has offered the officers of the Federal Lab Consortium access to an electronic mail system. So I put his request on the electronic mail, and less than 2 hours later I learned from Peg McNamara, who is here in the room—she is at the Naval Underwater Systems Lab in New London—that their lab had found a person, had made the right contact and the man at LTV in Dallas was about to fly this equipment out of Virginia to help. That would not have been possible had we not formed such an organization. I surely wouldn't have had close contact with Naval Underwater Systems in New London and wouldn't have thought of them had it not been for that organization.

So one of the things that we included in discussions with some of your staff, was the thought that perhaps through some establishment of an organization that we could have many things including a means for quick communication. As I mentioned, our lab has offered the service of an electronic mail service just to the officers, but we would like to be able to make that a real working system.

Thank you very much.

[The prepared statement of Mr. Stromberg follows:]

49-539 O - 85 - 4

STATEMENT OF

ROBERT P. STROMBERG

TECHNOLOGY TRANSFER OFFICER

SANDIA NATIONAL LABORATORIES

TECHNOLOGY TRANSFER AT SANDIA NATIONAL LABORATORIES

Sandia National Laboratories is one of the largest government-owned, contractor-operated (GOCO) laboratories. It is operated by AT&T Technologies, Inc. (formerly Western Electric Co.) through its subsidiary, Sandia Corporation. We are proud of our record of technology transfer. We have a computer file of over 530 recipients of over 161 technologies during the last four years alone. This record is the largest, to our knowledge, of any federal laboratory. These identified technology-transfer successes represent an effort by our staff valued at over $8 million annually, without counting efforts that do not have identified users. We are also proud of our support of state and local government. We have helped with prison design, environmental measurements, teaching at local universities, and a long list of other support activities.

Technology transfer has been a part of the culture of our laboratory since its beginnings in the Manhattan Project. Our primary job for the Department of Energy is engineering development of nuclear weapons. Our staff is primarily engineers, and interaction with American industry is continuous. We place approximately 9000 large contracts (over $1000) each year with private industry.

The large amount of technology transfer at our laboratory results from the knowledge by our staff that it is an inherent part of the job. Performance in technology transfer is a factor in determining promotions or raises. We are fortunate also that about 70% of our staff are engineers, with a natural motivation to see practical application of their work.

COMMENTS ON PL96-480 (STEVENSON-WYDLER ACT)

1. The designation "private sector" in PL96-480 is ill-defined. The act states that we are to preferentially support "U.S. industry," or those who help our international competitive posture. However, these organizations are not identified or defined, and we cannot determine which companies are contributing to or detracting from a favorable trade balance. We also cannot learn whether a company's R&D staff is in the U.S. or another country. Some emphasis on "manufacture in the U.S.," as in PL96-517, or provisions to help our competitive position on a long-term basis, would be an improvement.

In March of last year, the State of New Mexico paid my expenses to Japan to explain the access Japanese companies would have to technology from federal labs if they located in New Mexico. Before the trip, I spent considerable time with several economists and Department of Energy officials trying to determine the intent of Congress in PL96-480. All of us found it difficult to define the conditions that would be necessary before a foreign-owned company would be given the same free access to our technology as we give to domestic companies. Perhaps PL96-480 should set forth criteria that the Congress considers important in determining the domestic or foreign character of a company requesting access to federal-laboratory technology. Some suggestions are shown on the attached copies of viewgraphs which I used at seminars in Japan. The Japanese were extremely interested in the exact limits on these conditions, and brought this issue to the attention of our chief trade negotiator, Mr. Brock, two weeks later. I still feel very uncomfortable trying to interpret Congressional intent, and would like for you to consider clarifying provisions of PL96-480 in this regard.

2. The requirement in PL96-480 to prepare "Application Assessments" is too restrictive. There are many other ways to make users aware of available technology. The application assessment is a standardized form that suits some technologies but is inappropriate for others. For instance, our laboratory issues news releases to the specialized audiences of technical and trade publications. When the releases are read in these wide-circulation publications, our staff receives many inquiries, and the technology is thus widely disseminated to interested users. When we developed a new glass for use in long life batteries, a presentation by our staff at a ceramics society meeting resulted in transfer of this technology to a half-dozen companies. When we see large interest, we advertise and hold a seminar for those interested in the technology. The point is that many different methods can and should be used.

3. Many laboratories assign part-time personnel to the Office of Research and Technology Applications (ORTA). Since other duties usually claim the primary attention of those personnel, technology-transfer activities suffer. Full-time personnel are needed. Federal Laboratory Consortium networking really works only with full-time ORTAs.

COMMENTS ON H.R. 1572 and H.R. 695

1. The granting of rights to intellectual property generated from federal funding to private parties has been the subject of several Congressional actions in recent years. Three points are given for your consideration:

   A. Extension of these rights to private parties gives incentives for commercialization of a technology, but these incentives must be balanced against the potential for conflict of interest. Further, we see no reason why incentives for commercialization such as those set forth in these two bills should not be extended to GOGO laboratories and their employees.

   B. We do not understand why different treatment is given to contractors merely because they are universities, non-profit corporations, or small businesses, as compared to large businesses. A uniform policy appears desirable.

   C. Certain technological areas of critical importance to national security and public welfare may justify placing of conditions on the granting of rights to private parties. For instance, the need for closely integrated contractor groups in the nuclear weapon complex may result in the imposing of certain safeguards or conditions on the granting of private rights to protect free exchange of information within the complex. However, these conditions, in general, should not preclude commercial spin-offs.

2. We advocate support of the Federal Laboratory Consortium as specified in H.R. 1572. This is a network of people who share the talents of federal laboratories by referring requests for help. We have allowed Consortium officers to use an electronic mail system at Sandia. However, our system does not have the capacity to handle a FLC membership of some 200. The electronic mail is used to pass on requests to any federal laboratory having the most appropriate resources for responding. The following instance illustrates the system's usefulness. On May 10, 1985, I received an urgent call from LTV Aerospace Defense, Dallas TX, for equipment to find a downed pilot feared lost in a swamp or lake in southeast Oklahoma. My inquiry for assistance was placed on the electronic mail at 11:50 MST. At 14:02, Margaret McNamara, Naval Underwater Systems in Connecticut, reported that LTV had been given the name of Mr. Bob

Kutzleb, Steadfast Marine, Falls Church, VA, a company with specialized equipment for locating underwater objects. LTV was about to fly the equipment to the crash site when the network was informed that the pilot's body had been found.

The point is that the informal network located the best equipment for an emergency because a DOE laboratory person had rapid access to all other government labs, and a Navy laboratory in this case gave immediate assistance. Mr. Laden, the requester from LTV, called each of us back with his thanks. Not all requests are like this, but it is illustrative. If the Federal Laboratory Consortium could be assigned as a function of a federal agency such as the National Science Foundation, the chosen agency could link the total FLC membership in such a useful electronic network.

General Comments

We have been troubled by several studies which imply that the federal laboratories did not significantly help U.S. industry during the large budget years for energy programs. We feel that technology developed at Sandia had a significant impact in the energy industry. Our record of 530 successful technology transfers mentioned earlier applies only to the last four years. Had we kept a record in the late 70's, the record would have been even more extensive. A few examples illustrate our contributions in those years. A drill bit we designed (Polycrystalline Diamond Compact) is drilling nearly a third of all the footage underground, and saving as much as a million dollars on a single bit run. Our work in identifying and eliminating the tremendous heat losses in insulated tubing used for steam injection in tertiary oil recovery will save perhaps a billion dollars in energy over the next 10 years. Our solar-cell technology has been transferred to several companies. The most successful government-sponsored development of wind turbines, was our development of the unusual vertical-axis or Darrieus wind turbine now manufactured by several companies and being used worldwide. Any listing of a few specific items can be criticized, but our totals for successful technology transfer speak for themselves. Of course, our transfers from energy programs are decreasing now as budgets for these programs dwindle.

Final comments

The question has been asked, "What structural changes will accelerate U.S. technological innovation?" I argue for motivational rather than structural changes. During my visit to Japan I was amazed at the enthusiasm of the Japanese people. I also feel technology transfer should be made an assigned duty in all government labs.

PUBLIC LAW 96-480

"STEVENSON-WYDLER TECHNOLOGY INNOVATION ACT OF 1980"
(CLEARLY TO PROMOTE U.S. ECONOMIC POSITION)

SECTION 2 FINDINGS:

(1) --

(2) ...ENHANCED COMPETITIVENESS OF UNITED STATES PRODUCTS IN WORLD MARKETS

(3) --

(4) --

(5) ...INNOVATION IN THE UNITED STATES LAGGING WHEN COMPARED TO HISTORICAL PATTERNS AND OTHER INDUSTRIALIZED NATIONS

(6) ...REDUCE TRADE DEFICITS...INCREASE EMPLOYMENT...

(7)

(8) ...A STRONG NATIONAL POLICY SUPPORTING DOMESTIC TECHNOLOGY TRANSFER...

(9) --

(10) --

(11) --

SECTION 3 PURPOSE:

...TO IMPROVE THE ECONOMIC, ENVIRONMENTAL, AND SOCIAL WELL-BEING OF THE UNITED STATES BY...

ELIGIBILITY OF A FOREIGN COMPANY
TO
NATIONAL LAB TECHNOLOGY

I. PUBLISHED INFORMATION FREE, AVAILABLE THROUGH NATIONAL TECHNICAL INFORMATION SERVICE

II. BASIC SCIENTIFIC INFORMATION EXCHANGED FREELY

III. NEW TECHNOLOGY TRANSFERRED IN SEVERAL WAYS:

A. PATENTS -- SOME LABS ASK ROYALTIES, SOME NOT

B. ALBUQUERQUE OFFICE OF DOE REQUIRES EXCHANGE OF INFORMATION OF EQUAL VALUE (QUID PRO QUO)

C. CLOSE RELATIONSHIP WITH LABORATORY (CONTRACT) REQUIRES THAT GREATER THAN 50% OF COMPONENTS USED BE DOMESTIC (BUY AMERICAN ACT)

D. ACCESS TO INFORMATION WITHOUT EXCHANGE ONLY IF RECOGNIZED AS "U.S. INDUSTRY"

ELIGIBILITY OF A FOREIGN COMPANY
TO
NATIONAL LAB TECHNOLOGY

IV. RECOGNITION BY LABS AS "U.S. INDUSTRY"

A. A COMPANY INCORPORATED IN U.S. WHICH FUNCTIONS AS A TRADING COMPANY, IMPORTING 90% OF SALES IS DEFINITELY FOREIGN.

B. FOREIGN OWNED COMPANY, R&D STAFF OUT OF COUNTRY, IMPORTING KNOCK-DOWN PARTS FOR 60% OF SALES, ASSEMBLY IN U.S., PROFITS FLOWING OUT OF COUNTRY WOULD BE CONSIDERED FOREIGN.

C. A FOREIGN OWNED COMPANY, R&D STAFF IN U.S., MANUFACTURING IN U.S., WITH EXPORT SALES EXCEEDING SUM OF IMPORTED PARTS AND PROFITS FLOWING OUT OF U.S. WOULD PROBABLY BE CONSIDERED U.S.

D. NO DEFINITE LINES DRAWN, AWARENESS GROWING.

IMPORTANT CRITERIA

A. LOCATION OF R&D STAFF

B. BALANCE OF PAYMENTS (EXPORTS MINUS FOREIGN PROFITS AND IMPORTED PARTS)

Name

Robert P. Stromberg

Assignment

Technology Transfer Officer, Org. 4041, Sandia National Laboratories

Education

BS - Physics, University of Minnesota - 1949
MS - Physics, Minor Math, University of Minnesota - 1950* Minor EE
*(No MS Degree, lacked only two term papers and oral)

Patents

Weightlessness Switch, Patent No. 3,141,084, dated July 14, 1964.
Solar Tracking Sensor, about June 15, 1982.

Publications 3 Reports 16 Presentations 55

Employment Experience

Employed at Sandia National Laboratories, Albuquerque, New Mexico from September 1950 to present. Duties have been electro-mechanical design of components for weapon systems as well as supervision of advanced development on electromechanical components; advanced development effort on radioisotope power space generators; exploratory development work on new weapon systems, both nuclear and conventional; originated the Solar Total Energy Project with NSF and AEC sponsorship; Solar Energy Systems Studies; Solar Total Energy Project Management. From 1977 to 1981, Solar Technical Liaison Division, 4714. From July to October 1981, DOE representative at IEA solar power plant experiment, Almeria, Spain. October 1981, assigned Technology Transfer Officer, SNLA.

Recruiter of engineering personnel for Sandia National Laboratories at the University of Minnesota and Cal Tech.

Mr. WALGREN. Well, we appreciate that testimony. Very significant and good points made.

Let me recognize the gentleman from New Mexico. Our next witness is Dr. Stark, and I understand he, too, has a base in——

Mr. LUJAN. Well, little installations, both Mr. Stromberg and Dr. Stark. I get an opportunity to raise it with them quite often and I know their thinking on tech transfer, so I won't have—I guess this isn't the time for questions yet. Is that so?

Mr. WALGREN. Let us hear Dr. Stark at this point, and then we will turn to discussion.

Mr. STARK. Thanks, Mr. Chairman. My name is Gene Stark. I am with the Los Alamos National Laboratory in New Mexico, and I am here representing the Federal Lab Consortium for Technology Transfer.

As we have heard yesterday and today, the Federal laboratories clearly have a wealth of resources in technology that can and should be made pragmatically available to groups who may make good use of that technology. These groups include large industry, small business, universities, as well as State and local governments. My concern today is that this opportunity is far less than 50 percent effective, and so I would suggest that a crucial question facing your subcommittee is to what extent should major initiatives be taken to turn this important contingent asset of Federal technology into a fully working asset for the U.S. economy in both the public and private sectors.

In my brief remarks I would like to give a brief perspective on technology transfer, mention the growing activity and demand and suggest for your consideration some initiatives to leapfrog from the present voluntary, often ad hoc approach to technology transfer to a much stronger, although decentralized, technology transfer activity with a much stronger nationwide impact.

Yesterday you heard and discussed the issues of technology transfer and pickup by industry of technology from nongovernmental organizations. Federal technology transfer, however, must include an entire process that can range from informal assistance to major institutional collaborations to move technology from a Federal laboratory into an industry or another user of Federal technology. And in particular, as Dr. Suh mentioned from his experience at M.I.T., the key role of active linkage is this process is very important to bridge these institutional gaps. And we have particularly seen this from the agencies with very strong transfer programs such as NASA and the U.S. Forest Service. The key role of an active linker, an individual whose job it is to make sure that Government researchers talk and work with people on the outside.

Now, without going into a lot of detail because you heard a lot about it yesterday, the focus of the technology transfer process is really on person-to-person interaction. Very seldom is technology transferred via exchange of paper. And there are a variety of technology transfer methods that will be employed depending in a case-by-case basis on the culture of the laboratory, the identity of the user and the status and type of technology to be transferred.

An important aspect of this whole process, however, is that there have to be institutional and individual incentives to make that process work. The individual incentives can range from the merit

review system, as Bob Stromberg mentioned, to shares in patent royalties as has been suggested in the legislation before you now.

The institutional incentives include the fact that technology transfer can provide important perspectives and, indeed, technology to strengthen the missions of the Federal laboratories. And that is one of the reasons that we have felt the Federal laboratories in many cases have taken strong efforts in technology transfer.

I would also like to note very strongly the growing initiatives by States and cities in economic development to which the Federal research institutions are trying to link and the fact that we see a growing cooperation with some of the statewide organizations such as Penntap in Pennsylvania, the Ohio Technology Transfer Organization, which are serving to reach out to large and small business in their States. In fact, the far west region of the Federal Laboratory Consortium has been making an initiative with the California State University system as well as with the community colleges in California to help develop a statewide outreach system within the State of California.

And finally, from the process standpoint I will note, as Bob mentioned, that the ability to enter into cooperative agreements, which is already possible within the contractor labs of the Department of Energy, has proven to be extremely valuable, and we have examples of major technology developments and transfers that simply would not take place without the ability to enter into cooperative arrangements.

I would like to turn very briefly to the Stevenson-Wydler Act. My personal feeling is that one of the more important factors in strengthening of Federal laboratory technology transfer over the last 5 years has been the fact that this subcommittee under your chairmanship, Mr. Walgren, held oversight hearings in mid-1981, which I think for the first time made it very clear to the laboratories and agencies that the Congress was very seriously interested in seeing Federal laboratory technology transfer work. But as it stands, the Stevenson-Wydler Act is a permissive act rather than one that mandates effective results from technology transfer. And we will argue that what is clearly needed is a long-term commitment and mandate from both the administration and Congress to make all agencies and laboratories fully aware of the importance of technology transfer, that there be a development of committed resources within the Federal facilities and our Federal Laboratory Consortium, and at the same time a development of demand, making industry and State and local governments aware that our Government has a long-term commitment to make technology transfer.

Some important information was gathered by a Federal Lab Consortium/lab industry working group chaired by Claire Sink of DOE's Morgantown Energy Technology Center. They recently completed a survey of laboratories on technology transfer programs and successes. And based on responses from about 70 Federal R&D facilities they found that about half of those facilities had only part-time technology transfer agents, that 60 percent of those agents felt that there were significant barriers to technology transfer, and the most widely mentioned barriers were in the area of policy.

Further, in studying cases of successful technology transfer some of the clear lessons that came through were the importance of person-to-person interaction; the fact that technology transfer is a team effort both on the part of people inside the laboratory, the researchers as well as the management, as well as those on the outside; and again that a variety of technology transfer methods is required.

I would like to describe to you very briefly our Federal Laboratory Consortium, which I think is well-known by now to this committee. We have more than 200 Federal research and development facilities participating in the Federal Laboratory Consortium by choice, because they find it valuable to network among themselves for strengthening of technology transfer and to learn from each other about the methods of technology transfer, to cooperate in marketing the concept of technology transfer to potential users of our technology, and to work together on training of technology transfer people as well as some recognition.

I would like to consider, or suggest for your consideration two major thrusts that we believe would significantly strengthen Federal technology transfer. The first would be to transform the present policy from permission to mandate requiring results on a decentralized facility-by-facility basis; and second, to strengthen significantly present grassroots ad hoc cooperation among the laboratories. And I will be specific about six initiatives for your consideration that we feel would address these two major points.

The first is to mandate effective technology transfer with decentralized responsibility but expecting of every agency and every laboratory and every smaller facility positive results in technology transfer. And furthermore, require that all major laboratories have at least one full-time person assigned to technology transfer so as to have a very clear mandate and responsibility for that activity.

Second, technology transfer should be mandated as a key element within each Federal R&D Program.

Third, and I will go into a bit of detail on this. We would like to see a very great strengthening of the Federal Laboratory Consortium, which is now an operating ad hoc organization. We would like to see first of all a clear charter and an organizational home for the FLC with predictable support for our decentralized efforts so that our groups of laboratories in dealing with potential users can make reliable long-term commitments. This is something that is very important because, as some of our studies have shown, good technology transfer very often takes 1 year or even 5 years to take place, and particularly institutional relationships may take some time to develop to fruition. And therefore, it is very important to be able to have a stable base of people making sure that we can make long-range commitments.

Finally, we would stress that in any strengthening of the FLC all professional positions would be on rotational assignments from the Federal laboratories so as to continually focus on results rather than on organizational self-preservation. We would suggest that the National Science Foundation is the most ideal location for an organizational umbrella for the FLC, first of all because the foundation is clearly institutionally innovative and flexible. Perhaps the most important point is that the NSF enjoys a position of both

respect and neutrality among the R&D agencies that do have their own laboratories, and we have many examples of other laboratories and agencies able to cooperate with the National Science Foundation while preserving all their own management and policy prerogatives.

The National Science Foundation, as an organizational home for the FLC, would have no slant as to mission, technology, the methods of technology transfer, nor a preferred user community. And finally, the foundation has a broad charter, as diverse as that of the laboratories within the FLC.

We think that strengthening the FLC would very much strengthen the networking among the laboratories to provide both efficient access to people and organizations nationwide to the wealth of resources within the laboratories, as well as importantly making efficient, effective use of the resources in those laboratories. It would permit us to strengthen on a nationwide basis the marketing of the concept of technology transfer not only to organizations but to the bench level scientists and engineers who would pick up this know-how. And finally, it would permit us to take a stronger effort in developing methods, training and assistance to individual laboratories.

The fifth initiative that I would suggest is to develop regional and national forums, if you will, to network the networks. There are networks of university research administrators, of small business assistance centers, trade associations, professional societies. We have made some inroads into networking among and between the Federal laboratories groups and these individual networks, but an initiative to network those networks we feel could be very valuable.

Last, but certainly not least, would be to strengthen very much the effective use of cooperative agreements and the pragmatic availability of intellectual property for exclusive or nonexclusive licensing is an initiative that we feel would be very important, because we have seen many cases of lost transfer opportunities in the past because these methods were not available, and more recently very strong examples of positive transfers because in some cases such opportunities were available.

In summary, I think we would like to see a widening menu of methods so that each laboratory and agency can work in ways appropriate to its own mission and its own culture to achieve, as one man said yesterday, not paper, not reports, but actual results. This is an important challenge. We very much welcome the leadership of this committee in this area.

Thank you.

[The prepared statement of Mr. Stark follows:]

STATEMENT

before the

SUBCOMMITTEE ON SCIENCE, RESEARCH AND TECHNOLOGY

HOUSE SCIENCE AND TECHNOLOGY COMMITTEE

May 22, 1985

"Initiatives to Strengthen the Contribution of Federal Technology to the American Economy"

Dr. Eugene E. Stark, Jr., Chairman

Federal Laboratory Consortium

for Technology Transfer

and

Industrial Initiatives Officer

Los Alamos National Laboratory

Mr. Chairman and Members of the Subcommittee:

It is an honor to appear before you on behalf of the Federal Laboratory Consortium for Technology Transfer to discuss improvements in moving the results of federal research and development into the American marketplace.

The nation's need to maintain a strong economy and international leadership in science, technology, and their translation into international competitiveness demands that the federal facilities engaged in research, development, engineering and testing ensure that their unclassified technology is made pragmatically available to the US public and private sectors. Outstanding examples of transfer and technical assistance make it clear that there is a wealth of valuable technology in these facilities--but this process is operating overall at less than 50% effectiveness.

This Statement summarizes a perspective on federal technology transfer, the vital networking and support role of the Federal Laboratory Consortium, an analysis of the issues raised by this Subcommittee, and a set of proposed initiatives to strengthen federal technology transfer.

FEDERAL TECHNOLOGY TRANSFER - A PERSPECTIVE

Most federal laboratories' technology transfer programs have developed over the last decade. The strongest lessons learned from the experience of this decade (as well as NASA's longer-running program) include the value of personal interactions and the fact that many different methods of transfer must be employed. The variety of methods described below is needed to adapt the transfer process to the type of technology to be transferred, its stage of development, the location and technical expertise of the receiving organization, the mission and

institutional culture of the laboratory, and other factors. Even more important than the method of transfer is the process of linking a potential source of technology with a potential user of that technology. This active linkage process is an important element in successful transfer.

Past technology transfer efforts have already proven valuable to the public and private sectors. Specific examples will be given later, but the list of technology transfer clients includes:

Small Business. The role of small business in new-job creation and innovation is impressive. Informal technical assistance is provided by laboratory staffs; laboratory technologies are adopted and commercialized by small businesses; and some laboratory employees become entrepreneurs and establish technology-based enterprises. Federal laboratories also participate in broader programs to strengthen small and minority-owned enterprises through special procurement programs and through the Small Business Innovation Research program. These activities can significantly strengthen local economic development efforts.

Large Industry. Growing competition in international markets and the role of technology-based goods in US exports have focused attention on industrial innovation and productivity in the past decade. The federal laboratories contribute to these needs through the adaptation of their new technologies by industry, the creation of special staff-development opportunities and their ability to address specific technical needs of industry.

Universities. The federal laboratories provide important research and collaboration opportunities for faculty and students.

State and Local Governments. Through technical assistance and transfer of technology, federal laboratories are a resource for these governments in their efforts to enhance productivity and solve problems, particularly as demands on their services are growing.

Key Role of Personal Contacts

The primary underlying approach in virtually all technology transfers is the key role of person-to-person interactions. A definitive study made at the Sandia Laboratories identified the characteristics of over 72 successful transfers[1]. The results show that the key events initiating the transfer were overwhelmingly face-to-face contacts including presentations, conferences, workshops and personal discussions.

Analyzing the methods used in then transferring the technology, person-to-person interaction was employed in 42% of the successful transfers; reports and journal articles were a factor in only 25% of the cases. Preliminary analysis of new results covering 163 successful transfers by Sandia reinforces these results, as do the results of a more recent survey discussed later.

Personnel Exchanges

Temporary assignment of technical staff to another organization can be a very effective means of gaining either existing know-how or detailed perspectives on a technical program from hands-on involvement. The Research Associates program at the National Bureau of

(1)"Technology Transfer at Sandia National Laboratories: First Annual Report," Sandia Report SAND83-0345, March, 1983.

Standards (NBS) permits use of unique facilities and expertise that would otherwise be unavailable to the sponsoring companies or trade associations. Through this mechanism, for example, a significant fraction of dental-care and fire-protection innovations and tests are made by industry representatives working at the Bureau. The Los Alamos National Laboratory has an Industrial Staff Member program for a one-way assignment of industry staff, with recent participation by Westinghouse, Grumman, and SCIPCO.

Many laboratories have similar programs with universities, with staff receiving release time to teach at local universities, and sabbatical programs for year-long full-time assignments at universities or other technical institutions. There are also many programs for faculty and graduate students to perform research at the laboratories.

Under the Intergovernmental Personnel Act (IPA), many laboratories, particularly in the Department of Defense (DOD), have assigned staff as science advisors to state and local government groups, and university and public-sector staff have taken temporary assignments within the laboratories. As examples, there have been IPA assignments by the Naval Underwater Systems Center to the Connecticut State Legislature, by the Naval Ocean Systems Center to the Governors' office in Oregon, and by the Navy Personnel R&D Center to SANDTAC, the San Diego Technology Action Center. Sandia Laboratories provides its staff release time for teaching at the University of New Mexico (UNM); the Oak Ridge National Laboratory and the Lawrence Livermore National Laboratory have special arrangements for their staffs to serve as faculty at local universities.

Collaboration and Use of Special Facilities

Some government agencies support joint laboratory-industry programs to take advantage of special laboratory facilities or expertise and with immediate technology transfer opportunities for the private partner. Such relationships also permit the market-oriented expertise of the company to help direct the technical program in ways that will hasten commercial applications. Examples of this approach include joint programs under development between the steel industry and DOE's National Laboratories, several NASA programs, the Center for Process Control at the University of Tennessee (in cooperation with the Oak Ridge National Laboratory) and a National Institutes of Health-sponsored program to develop a nucleic-acid sequence data bank to support the genetic engineering industry (involving Bolt, Beranek and Newman and Los Alamos).

Special centers have been developed to draw upon the expertise of laboratories, universities and industry. These typically focus on broad areas of technology that can be pursued cooperatively, at least until specific market opportunities arise. A Center for Advanced Research in Biotechnology was recently formed by the NBS, the University of Maryland and Montgomery County, MD. Lawrence Livermore Natonal Laboratory is cooperating with the National Tooling and Machining Foundation to exploit and develop expertise in precision machining. The Federal laboratories in New Mexico are cooperating with a Center for Explosive Technology Research at New Mexico Tech and a Plant Genetic Engineering Laboratory at New Mexico State Unviersity, and the Los Alamos-UNM Center for Non-Invasive Medical Diagnostics.

When the laboratories have expertise not otherwise pragmatically available, they can perform industry-funded R&D. Recent policy changes by the DOE permit an industrial sponsor to gain title to resulting patents and data. Industry-funded projects can be accepted by NBS, NASA, DOD, and DOE facilities.

One special mechanism is the formation of computer software users' groups, benefiting the originators and all users of major scientific programs through sharing of problems, improvements and new applications.

Cooperation with Broker Organizations

There are some "broker" organizations who determine the needs of a group of similar organizations and match these needs to technology resources. PENNTAP is one of the oldest such organizations, serving the state of Pennsylvania. Public Technology, Inc., serves this function for many city and county governments. The Ohio Technology Transfer Organization (OTTO), operating through the state's community college net, assists small businesses. A formal Memorandum of Understanding between the State of Ohio and the Aeronautical Systems Division at Wright-Patterson Air Force Base has strengthened OTTO's linkage to this facility, and to all federal laboratories through the FLC network.

Several states have Small Business Development Centers that provide a wide range of assistance to small businesses. Many public-interest groups, such as the National Governors' Association, the National League of Cities and the US Conference of Mayors have special programs to assist their members. Many of these groups work with federal laboratories through the Federal Laboratory Consortium because it provides efficient central access to many laboratories.

Professional and trade associations have some special programs that assist in creating demand pull. The American Society of Mechanical Engineers has a special state and local government relations office. The Society of Manufacturing Engineers recently compiled a detailed compendium of manufacturing technologies needed by industry.

Technical Assistance - Institutional and Individual Volunteerism

As noted earlier, there are mechanisms for Laboratory staff to work directly with state and local governments and universities on programs of mutual benefit.

Under the Stevenson-Wydler Act's mandate, many laboratories solicit or receive requests for technical assistance in state and local government problems. Similar assistance is often provided to industry.

Another rapidly spreading model involves special volunteer programs for employees and retirees of federal laboratories. The Naval Underwater Systems Center developed Technical Volunteer Services with active and retired employees, with a primary focus on community needs in Connecticut, Rhode Island and Massachusetts. Aided by the efforts the Federal Laboratory Consortium, this model has been duplicated at several other laboratories.

Creation of Demand

Because successful technology transfer is often not a major goal of federal laboratory programs, there can be a chicken-and-egg problem of finding needs and available technology to fill those needs if the source and potential user of the technology are not already working together. Both federal laboratories and outside organizations approach this issue by developing efficient forums in which a variety of

technology areas can be described to many potential users, or needs described to potential sources.

Several types of conferences have been developed, including the Industry-Federal Laboratory Conferences organized by a nonprofit corporation, Technology Transfer Conferences, Inc., in cooperation with the FLC. Through cooperation of several laboratories in the Federal Laboratory Consortium, major conferences and expositions have been organized in Philadelphia, Baltimore and Albuquerque, covering a broad range of technical areas. Specific areas have been the focus of workshops aimed at developing collaboration partners, including one in materials at Oak Ridge and one on plant biotechnology at Los Alamos. The Industrial Research Institute, through the IRI-National Laboratory Working Group has organized "Spotlight" conferences at Argonne, Brookhaven and Oak Ridge. The American Institute of Aeronautics and Astronautics has organized for NASA a series of in-depth conferences at NASA's research centers. The Commercial Development Association, comprising primarily chemical companies, has sponsored visits to Sandia, Los Alamos and Brookhaven.

Of particular note are special efforts to develop policy forums of public and industry officials and laboratories to strengthen the environment for technology transfer and to develop new initiatives to accelerate the transfer process. The RGK Foundation and the IC^2 Institute at the University of Texas at Austin have sponsored three such conferences.

Entrepreneurship

The entrepreneurs spinning out of all technical institutions are creating genuine excitement and rapid commercial innovation. The fed-

eral laboratories can claim many such spinoffs, and some have activities that encourage entrepreneurship.

The Federal Laboratory Consortium is cooperating in a project with the US Conference of Mayors to link federal laboratories with cities to encourage technology-based economic development. The Los Alamos National Laboratory co-sponsored a workshop on small-business "incubator" facilities to assist a local effort to develop an incubator, which recently began operation.

Several employees left the Harry Diamond Laboratory to commercialize a fluidic pyrometer technology that can measure molten steel temperature with sufficient accuracy and lifetime to assist in process control. They joined a small company, Accumetrix, located in Virginia. Through FLC contacts, early materials needs in the original laboratory project were answered by personnel at the National Bureau of Standards.

A particularly innovative approach was used in a transfer recently initiated from the Los Alamos National Laboratory. A new small business, Mesa Diagnostics, was organized specifically to commercialize laser-based systems for rapid identification of bacteria and viruses. It obtained financial backing from several venture capital funds and research funding from a major pooled R&D limited partnership fund, and negotiated a patent license from the University of California, the operator of the Los Alamos facility. Mesa Diagnostics is funding completion of the needed research by Los Alamos under a contract with the Department of Energy.

Licensing of Intellectual Property

Beginning with passage of the Bayh-Dole Act in 1980, there has been a growing effort to make patents developed at government expense pragmatically available for commercial applications. Because many government-sponsored inventions require a significant further investment in development before they can achieve commercial sales, the lack of availability of exclusive licenses has been the Achilles' heel of some potential technology transfers.

This method of transfer from the federal laboratories is in its infancy, but early results indicate that the incentive provided by exclusive licenses and the royalty-based incentive to inventors and their organizations are catalyzing the careful development of licensing programs for federal technology. So far, the more effective marketers of license opportunities have been the inventors and their immediate organizations.

Local Economic Development Initiatives

Individual federal facilities have cooperated in economic development initiatives that create a strong pull and supportive environment for new technology spinoff enterprises.

South Jersey Technology Consortium - Under initial encouragement from the director of the FAA Technical Center and Rep. William Hughes, this consortium has been formed to enhance economic growth. Members include the Congressman's Office, the FAA Technical Center, the FLC's Mid-Atlantic Region, the South Jersey Economic Development Council, Stockton State College and Governor Kean's Commission on Science and Technology.

Los Alamos Small Business Center - In 1983, a private economic development corporation was organized to assist technical spinoffs from the Los Alamos National Laboratory into the local community and northern New Mexico. After organizing the nation's first workshop on small business incubators, it established a local incubator, the Los Alamos Small Business Center, under strictly private financing. This Center will open formally this week at 90% occupancy.

Jefferson County, Colorado - Officials at the Solar Energy Research Institute are working with local businessmen to develop an innovation center. Experience from other federal facilities' efforts is being provided to this group.

Federal Technology Transfer Survey

The FLC organized a Federal Laboratory-Industry Working Group to develop methods to strengthen technology transfer relationships. This group, chaired by Ms. Claire Sink, Morgantown Energy Technology Center, recently completed surveys of the federal facilities' approaches to technology transfer and analyses of transfer case studies.

The Group analyzed responses from 69 technical facilities of 9 federal agencies. Some major statistical results were:

43% reported that the Stevenson-Wydler Act notably affected their technology transfer activities.

49% have only one part-time person assigned to the transfer function.

74% were aware of an agency transfer policy; these reported a greater variety of and emphasis on transfer efforts.

26% reported having a technology transfer policy within their facility.

57% reported significant barriers to their technology transfer activities. Those barriers mentioned most often related to

emphasis and policy, for example lack of support and understanding of the value of technology transfer.

65% felt the FLC was moderately to very helpful in the facility's transfer program.

The cases studied represented 55 transfers from 20 facilities.

- The greatest number of recipients were large and small business, but other federal facilities were also prominent.

- The most frequent recipent of transfer was the manufacturing industry.

- A wide variety of transfer methods was reported, usually several used together per case, including personal discussions, visits, technical publications, technical meetings, government publications, patent licensing, training, cooperative programs, sharing of facilities, cost-shared R&D, and personnel exchanges.

- Major commitments were made by both the federal facility and the recipient of the technology: 54% of the transfers took 1-5 years while 11% took more than 5 years.

- Transfers most often required cooperation among the researcher, facility management, local or agency technology transfer personnel and patent staffs.

- The key individuals in the receiving organizations were: large business-commercial development, technology assessment and patent staffs; Small business-researchers and the CEO; and contacts in professional societies, trade associations and universities.

Although the above information represents only a small fraction of the study's useful results, it reinforces the following points:

o Government policy has had an important role in strengthening the technology transfer process, particularly as it is reflected in agency and facility policies.

o Person-to-person interaction is the key underlying element in technology transfer.

o A variety of methodologies and case-by-case flexibility is important in successful technology transfer.

The Role of Institutional Culture

The role of MIT's staff in creating the technology-based industry around Route 128 is well known. Studies of other institutions by MIT[2] have indicated why MIT has succeeded where other good universities have not spawned such activity: Applications of science and technology, consultation, and entrepreneurship by the staff at MIT is strongly encouraged by the Institute's culture. Such activity is respected, is a positive consideration in faculty promotions, and is viewed as strengthening MIT's research and educational roles.

Without belaboring the importance of this observation, we must conclude that effective federal technology transfer must rely on: (a) a genuine, long-term commitment by the Administration, the Congress, the agencies and the federal facilities to make it work; and (b) the design of each facility's program to complement its existing institutional culture.

[2]Dr. Nancy S. Dorfman, presentation to Technology Transfer Society Annual Meeting, Boston, June 26, 1984.

Incentives for Effective Transfer

Many incentives have been identified or developed for successful technology transfer. For example, NASA's integrated system of performance awards provides incentives to individuals for technology transfer. The strongest transfer programs would include incentives to the agency, the facility, all levels of management and the technical staff. These can include for the facility a recognition that active technology transfer both enriches the staff and provides opportunities for infusion of mission-strengthening technology and activities into the facility. In the particular case of patent licensing, the government lacks industry's flexibililty in rewarding important innovations; the use of patent royalty income to provide recognition and incentive for both commercially-valuable innovations and important mission-related advances could be important. Universities have many different policies for royalty-sharing with inventors in particular: 20% of net royalties is typical, but the common range varies from 10% to 50%, with some universities having sliding scales under which the percentage decreases as the income exceeds certain levels. In some cases, major shares (10-20%) are also paid to the inventor's academic department for research or equipment. It appears that universities provide these shares because of: the additional effort often taken by inventors to disclose, develop and to help market the patent; the need for an incentive for this process, for which there is otherwise little or no recognition or reward within the university culture.

Cooperative Agreements

The value of cooperative agreements is most easily shown in the case of the Department of Energy. A 1982 class waiver permitted

sponsors to obtain title to patents developed at their expense by the DOE laboratories. This development provided the basis for a major expansion, still accelerating today, in R&D cooperation between these laboratories and US industry. The authority to negotiate these agreements rests with the DOE field offices, a situation that provides both the values of decentralization and adequate DOE control over the general trends and the details of individual agreements.

Illustrative Examples

The US Army Construction Engineering Research Laboratory (CERL) developed a portable washer that uses high-pressure hot water with vacuum retrieval of the waste water. The washer is ideal for cleaning and sanitizing refuse dumpsters, cleaning up chemical and oil spills, and on-site cleaning of equipment. Design specifications were transferred to two independent companies for marketing of the washer.

X-ray flourescence, a nondestructive method of elemental chemical analysis, was developed by Lawrence Berkeley Laboratory. This analysis method, based on the phenomena on x-ray emission, can be used for material studies, resource exploration, archaeology, criminology, trace analysis, and other studies. This technology is available to companies such as North American Refractories through commercially sold x-ray test units. North American Refractories uses three units that employ this method to analyze mineral ores and refractory products. The method is relatively clean and quick and is capable of reducing the 50 to 100 man-hours needed for conventional wet chemistry methods to less than one hour.

The City of Callaway, Florida consulted the Air Force Civil Engineering Center regarding the preparation of a statement of work and

the selection of a contractor to prepare the city plan required by the state. The consultation and the follow-up evaluation of the plan were both done on a volunteer basis.

Applications concepts for microcomputers are available to the public and private sectors through a series of three videotape training packages offered by the Lawrence Livermore National Laboratory (LLNL). The California Department of Water Resources concluded that the method of monitoring water flow rate and accumulated water volume at the Oroville Dam was inefficient and susceptible to errors. The installation of a microcomputer system, adapted from LLNL's system provided the greater speed and accuracy needed for operating the Dam's turbines.

THE FEDERAL LABORATORY CONSORTIUM FOR TECHNOLOGY TRANSFER (FLC)

The FLC is a partnership of over 200 federal research and development laboratories and centers. Members are responsible for 85% of all federal laboratory research and development. Its goal is to provide the environment, the operational structure and the transfer mechanisms to support the fullest domestic use of unclassified federal technology. The Consortium's role is to assist its member laboratories in:

o Development of effective technology transfer methods and mechanisms;

o Transfer of federally developed technology to domestic public and private organizations;

o Application of federal talent, where appropriate, to domestic public and private needs;

o Establishment of networks with the rest of the technical community to refer requests or engage in cooperative efforts.

The FLC provides the only interagency, interlaboratory forum on technology transfer, and therefore facilitates significant cooperation among these institutions. Important results include: training of individuals newly assigned to technology transfer; the transfer of new technology transfer or cooperative mechanisms among the laboratories; and increased effectiveness and efficiency of each laboratory's transfer program through national outreach activities and efficient brokerage of technology needs and opportunities. Particularly as laboratories begin new or expanded efforts in technology transfer, this interpersonal network of experienced individuals has been a valuable resource for these laboratories in developing programs that

are both effective and complementary to their organizational cultures and missions. This cooperation has also proven directly valuable to the laboratories' missions through interlaboratory cooperation and laboratory-laboratory technology transfer.

The FLC is organized into six regional groups, each with a designated Regional Coordinator. These Coordinators form the FLC's operational backbone by serving both as (a) primary referral points in the network, brokering requests from their regions to the appropriate laboratories; and (b) organizers of special regional projects and efforts to market the availability of technology transfer to industry, state and local governments and universities in their areas. The FLC is governed by its member laboratories' appointed representatives through an elected Executive Committee; it has an advisory committee drawn from representatives of users. It holds national meetings semiannually as a forum for formal and informal exchange of information among member laboratories' representatives, and representatives from state and local government, universities, industry and Congress.

Networking

Because it represents a large resource of federal laboratories, the FLC can establish relationships with many organizations and groups representing potential users of laboratory technology.

Memoranda of Understanding - Several formal Memoranda of Understanding have been generated between the FLC and entities that share its interest in technology transfer. Existing agreements are with: Training Resources and Data Exchange; the Department of Commerce; US Conference of Mayors; Public Technology, Inc.; Florida Small Business Development Centers (and the Southeast Region, FLC); NASA Industrial Applications Center (and Farwest Region, FLC).

For the several states and areas without major federal laboratories, the FLC network can provide a unique opportunity to make federal technology and assistance available through the FLC regional coordinators. Two examples of enhanced interactions with such states have resulted from holding FLC-sponsored meetings: As a result of an FLC semiannual meeting in 1983 in Biloxi, numerous contacts and transfers were made between laboratories across the country and state agencies in Mississippi. At this FLC meeting, the representative from the Army Aviation Systems Command in St. Louis met a university professor who is now the science advisor to the Governor of Missouri. As a result of this contact, this representative will participate in an economic development conference sponsored by the Governor's office.

Because federal technology transfer is very resource limited, this mechanism has not been extended to all such states and locales. Special efforts by out-of-state laboratories have been made, for example, with Missouri, Oklahoma, Texas, Oregon, Mississippi, Hawaii, Arizona and Nevada.

COMET Electronic Mail System - Sandia National Laboratories have provided access to use their COMET Electronic Mail System to the FLC Executive Committee and representatives in the Sandia-coordinated Mid-Continent Region. It is used to circulate requests for information and assistance from FLC clients to the six regions via the Regional Coordinators.

One example illustrates its utility. The ORTA at Argonne National Laboratory relayed a request for information on electroluminescent signs to regional coordinators via COMET. Ninety minutes later, the ORTA at the National Bureau of Standards had relayed the request to a local expert who telephoned the requestor in Minnesota that day.

Examples of Networking Results - The Naval Underwater Systems Center heard about a computer software learning program developed at the Navy Personnel R&D Center. The program was created to teach vocabulary and literal comprehension specifically for Navy terminology and technical reading, but can be used to enhance those skills in any content area. NUSC decided to test it in a local school system for which their volunteer service was helping to develop a computer curriculum and computer requirements design. A workshop at NUSC, given by the NPRDC developer of the program, was attended by the Army Human Engineering Laboratory representative and he is now experimenting with it for a Reading Skill Improvement Program for the National Commission on Libraries and Information Science and the Baltimore County Public School System. To that end, a workshop was held at Harry Diamond Laboratory to train volunteer teachers to use the program.

Harry Diamond Laboratory had contact with Montgomery County, Maryland through its volunteer effort. A problem was identified in public works. The county needed information on waterproofing older (historic) brick buildings, and was especially interested in polymer coatings. HDL arranged for: a) advice from National Bureau of Standards on protection of brick buildings and b) evaluation reports on polymer coatings from the Army Corps of Engineers Waterways Experiment Station, Vicksburg, Mississippi.

A volunteer effort to provide an energy assessment for the East Lyme (CT) High School had direct benefit to a newly purchased industrial plant in Cambridge, Ohio: A request for assistance from a local assistance group, TRACES, to the Wright-Patterson Air Force Base was networked to the Naval Underwater Systems Center, which provided contacts on the project at East Lyme.

The Naval Air Development Center, PENNTAP and the FLC cooperated in transferring the Navy Preventive Maintenance Program to local governments through workshops and other assistance.

Through the FLC, the Naval Air Development Center (NADC) compiled information from three other agencies' laboratories on waste management, disposal and incineration for energy production. NADC is working with a consortium of townships in Pennsylvania to demonstrate and transfer this technology.

Development and Replication of Transfer Methods

Developing a technology transfer project within a laboratory can be time-consuming in addressing all operational and policy issues. The FLC assists both in developing transfer methods and in documenting successful approaches and transferring them to other laboratories.

Technical Volunteer Services - FLC member laboratories such as the Naval Underwater Systems Center (NUSC), along with several other public and private organizations, have taken the lead in establishing Technical Volunteer Services, available to communities surrounding their laboratories.

The FLC, with support from the Departments of the Army and Navy, the Administration on Aging, and individual laboratories, has been the vehicle for providing information, encouragement, training and assistance in establishing a TVS in all interested laboratories.

The FLC holds informational and training sessions on the intricacies of establishing volunteer services at its semiannual meetings. The FLC provides the forum for exchange of information and experiences, as well as the sharing of training aids among the laboratories.

The extension of this concept to other laboratories through the FLC has resulted in nine new programs in the past two and a half years.

Technical volunteers from the Naval Underwater Systems Center are working on a variety of aids for the physically handicapped. A task force of employees from NUSC's New London Laboratory are adapting toys and mobility vehicles for young (eighteen months to three years) cerebral palsy victims. The ability to use the adapted toys allows the children to gain some of the learning experiences that benefit unimpaired children. Members of NUSC's Newport Laboratory staff have developed a computer software program and adapted peripheral devices to assist young adults with cerebral palsy in improving their fine and gross motor control. These volunteer efforts have provided custom computerized communications systems to over 20 profoundly disabled individuals.

Expertise Data Base - The FLC, in cooperation with the Naval Material Command, supported development of a Technology Transfer Data Base at the Naval Weapons Center. Within the laboratory, it is used to locate individual technical experts for both mission requirements and for response to technology transfer inquiries. Although this detailed information is available only within the laboratory, for security and other reasons, a summary data base will be made available to other laboratories as a resource base for technology transfer referrals. Ultimately, through the FLC, it could be an important resource for all federal laboratories' internal operations, other mission needs, and technology transfer.

Technology Transfer Program Planning - The US Forest Service has developed a technology transfer program planning process to ensure rapid transfer of its developments in each program. Information on this process has been transferred to other laboratories through the FLC for their use.

Federal Laboratories Resource Directory - The FLC has taken the lead in proposing an interagency effort to develop a directory of federal laboratories, their major program areas and key capabilities.

The directory is intended to be an automated data base with inputs from the participating agencies. Two categories of applications are envisioned: information dissemination and laboratory management. A committee of FLC, Agency and CUFT representatives is working on locating a funding source and agreeing on specifications.

Marketing

Developing interest in potential users of federal technology, and making the links between the source and user of a technology are formidable tasks. These are assisted by the FLC through nationwide outreach activities (brochures, exhibits, articles), and the networking functions described earlier.

FLC-Industry Workshops - One need in effective networking is to provoke efficient communication between disparate groups. In cooperation with Technology Transfer Conferences, Inc., three laboratory-industry workshops have been held. Each workshop gives exposure of 10 laboratories to 30 major companies. Most laboratories report follow-up interactions based on these workshops, which are especially useful to smaller laboratories that are not known well by industry. Two such workshops focusing on new materials and processes and agricultural and biotechnology will be held in Philadelphia this October.

FLC-University Common-Interest Group - The FLC recently established a steering committee of individuals representing universities from five states to develop an FLC-University Common Interest Group. It will work to develop a national network of cooperation within which universities and federal facilities can cooperate in technology transfer; it will also strengthen FLC cooperation with universities through existing university-based organizations, such as the National Association of Management and Technical Assistance Centers and the National Productivity Network.

This is an extension of efforts in the FLC's Far West Region members in developing cooperation with the California State University campuses and the community colleges in California to develop a technical assistance network analogous to the Ohio Technology Transfer Organization.

Newsletters - TECTRA is an online interactive computerized data bank of successful technology transfer cases. TECTRA is the first system that has compiled information and documented user experience with successful federal laboratory innovations. In 1984 over 2500 requests for further information were received, based upon TECTRA's monthly newsletter.

TECLAB is a computerized data base of new technologies developed by federal laboratories and available for commercialization. A TECLAB case newsletter is published monthly as part of the research project funded by the Department of Commerce Minority Business Development Agency and the FLC. The newsletter and search service are provided at no cost to the requestor. 7600 copies of the newsletter were distributed in 1984, yielding 1500 requests for further information.

Surveys of subscribers to these newsletters have indicated strong interest in their technologies and good response from the laboratories in followup contacts. These are projects of the School of Business and Public Administration at California State University, Sacramento.

Recognition

Awards for excellence in technology transfer were established in 1984 to recognize laboratory employees who have been responsible for important transfers, but for whom technology transfer is not a major job responsibility. These and awards for FLC representatives and others help provide recognition and incentives for effective technology transfer.

Training

Through the FLC, both formal and informal training assists individuals new to technology transfer or those interested in new methodologies. About 25 new laboratory representatives receive orientation at each FLC semiannual meeting. Special training sessions on establishment of volunteer programs have been presented. Sessions have been held at FLC meetings to introduce such subjects as trade association interactions, patents, issues in militarily critical technology, the needs of the aging, university interactions, state and local economic development, and technology transfer between federal R&D organizations.

The FLC's network also provides valuable person-to-person advice both to assist new technology transfer professionals in their new programs and to assist each other with ideas, perspectives and problem-solving in specific technology transfers.

Mission Benefits

Effective technology transfer professionals are aware of the technology, expertise and needs within their own laboratories. Through the FLC's forums and network, there are opportunities for laboratory-to-laboratory transfer and cooperation for direct mission purposes. In addition, in many technology transfer situations, particularly with industry, there is a two-way transfer that enhances the labortory's technology base for mission work.

EPA Region III Office (Philadelphia) working through the FLC, surveyed technical resources that could be used in emergency hazardous/toxic waste problems. As a result of this survey, EPA was able to utilize special equipment developed at the Naval Explosive Ordnance Development Center, Indianhead, Maryland to locate a large group of buried barrels of hazardous waste at a site that became designated for Superfund activities.

Other Support Activities

FLC/Agency Liaison Group - In 1983, the FLC organized an Agency Liaison Group. This group has become a regular interagency forum on technology transfer issues, policies and methods. It also provides the FLC with input from its member laboratories' parent agencies on improving its services.

Federal Laboratory Directory 1982 - FLC cooperated with National Bureau of Standards' ORTA, in the preparation of the directory, NBS Special Publication 646 issued in 1983. It contains various summary data and an information sheet on each laboratory. NBS has disseminated 3,000 copies. Recipients were all federal laboratories, 700 industrial organizations, policymakers in the Agencies and Congress, and repository libraries. An updated edition is in progress.

COMMENTS ON THE STEVENSON-WYDLER ACT

The Stevenson-Wydler Act has engendered a significant increase in the number of laboratories active in the FLC, approximately doubling since its passage, and in increasing the interest of industry and state and local governments in technology transfer.

Several changes in the Stevenson-Wydler Act would significantly strengthen it. It could be viewed today as a permissive Act, rather than one that mandates effective technology transfer. The Act's permission to waive the requirement for full-time professionals in major laboratories should be removed. Only a person with full-time responsibility can ensure that the process works - if this is only a part-time duty, the individual often feels more comfortable with his other assigned duties rather than working tenaciously to instill effective technology transfer into the organization's culture and mission.

The specific requirement for application assessments should be relaxed. The general goal of reviewing laboratory programs for present and future transfer potential and communicating the results can be valuable, but the specified methods of review and communication have not been uniformly effective.

Each laboratory with an annual in-house budget exceeding $20 million per year should be required to assign at least one professional full-time to technology transfer; agencies with smaller facilities should dedicate full-time staff on a regional or national basis.

State/Local Governments

Section 11 (c)(4) implies that the laboratories may passively await requests for assistance from state and local government. The

experience of many laboratories is that active efforts by the laboratories to establish working partnerships will lead to many more opportunities for valuable assistance. This section of the Act might be modified to encourage such active efforts.

CUFT Role

The present actual role of the Center for the Utilization of Federal Technology (CUFT) is that of compiling and distributing written reports and summary lists of contacts and technologies in the federal laboratories and other organizations. This valuable support function is consistent with its location in the NTIS. Because several of its Stevenson-Wydler functions, viz. sections 11 (d) (2) and (4), are being implemented by the FLC instead of by CUFT, they should be removed as CUFT responsibilities. This change would remove some confusion among technology users and even some federal laboratories as to the actual present roles of CUFT and the Federal Laboratory Consortium. The FLC and the CUFT recently developed a memorandum of understanding to delineate their roles and to strengthen their cooperation.

Problems

The problems in effective technology transfer are found on both the supply and demand sides. Effective transfer programs at the laboratories require: (a) management commitment that can be instituted by the Administration, the Congress and the Agencies with clear mandates and accountability for results; (b) dedication of full-time transfer personnel with the qualifications and program commitment needed to develop transfer methods and outside contacts; and (c) interlaboratory networking to increase the effectiveness and

efficiency of each laboratory's program. Demand-pull by potential users of federal technology is developed primarily by extensive outreach and personal contacts. Our experience, supported by the results of Sandia Laboratories' technology transfer survey, indicates clearly that active, person-to-person efforts are the most important approaches to initiate user interest.

Concomitant with the potential value of federal laboratory technology transfer are concerns for national security and for preserving for American industry the benefits of federal technology. Partly through active efforts of the FLC, the member laboratory representatives have been educated on the issues in critical technology export controls. Several laboratories have assigned to one office the responsibilities for both domestic technology transfer and export control analyses: This has proven an effective combination that strengthens both efforts. More difficult is the issue of preserving for the US economy the best use of federal technology. Definitions of a US company and methods of analyzing the net effect of transfers on the US economy have been considered, but with no definitive guidelines. This is a subject that should command the attention of high-level policymakers. Relevant issues include the effects of transfers on US economic strength, on the balance of trade, on foreign investment in the US, on US international competitiveness and the company's R&D location (with resulting opportunities for local spinoff enterprises).

INITIATIVES

Special Access for Small Businesses, Universities and State and Local Governments

The technology, facilities and expertise at the federal laboratories have proven valuable to small business and have even formed the basis for many new businesses. The important contributions of small business to national productivity, innovation and employment are well recognized at all levels in the government. Similarly, university research and education is the backbone of the nation's intellectual strength; and the effectiveness of state and local government services has a major impact on our standard of living; however, the bureaucracy can be reluctant to approve new interactions between these entities and the federal laboratories. This aversion to risk or change could be dramatically assuaged by clear direction from national leadership. An initiative to provide streamlined access to the laboratories could begin with a strong encouragement of each agency and laboratory to examine its policies, rules and procedures with respect to facilities access, equipment loan, technical assistance and other methods of cooperation; and to shift their emphasis to stress technology transfer results over restrictions.

Mandate Effective Technology Transfer by Each Laboratory

Visible Congressional interest in technology transfer as an important part of each laboratory's mission, including requirements for submitting plans and results as part of the agencies' budgeting and appropriations process, would strengthen federal technology transfer.

Several agencies and laboratories have been very aggressive in creating new methods of technology transfer. One change in the approach to program/project/policy approval could encourage an entrepreneurial spirit in technology transfer within each laboratory: couple the mandate for effective technology transfer with an approval process that audits the propriety of past activities rather than to require detailed prior bureaucratic approval of all unusual and even some routine transfers. (All prior reviews for security classification would, of course, be maintained).

As discussed earlier, an emphasis on technology transfer results from each federal laboratory and requirement for dedicated full-time staff will significantly strengthen this process.

The central role of each laboratory in the technology transfer process should be recognized, and stronger participation and networking through the Federal Laboratory Consortium for Technology Transfer should be encouraged.

Strengthen the Federal Laboratory Consortium

The FLC is a volunteer organization: laboratories and centers belong by choice, and some of these organizations provide funds for outreach activities and general contractor support. All officials of the FLC serve at the discretion of their federal facilities. The success of this present volunteer approach indicates the FLC's value to these facililties, but it also limits overall effectiveness. Encouraging additional financial support and laboratory participation can accelerate the strengthening of this network, developing stronger outreach mechanisms, utilizing electronic mail and providing effective resource directory capabilities.

Formal establishment of the FLC would provide: a) a clear signal that interagency working-level cooperation should be strengthened; and b) significantly increased credibility with agencies, federal R&D facilities and with potential users of federal technology (and their common-interest groups) by indicating that reliable, significant, long-term relationships and commitments can be developed and honored.

The FLC's Executive Committee would suggest the National Science Foundation as the most desirable location for a formal FLC, because: the Foundation is viewed as neutral by agencies with assigned R&D missions; potential FLC activities could complement the Foundation's goals by fostering stronger nationwide cooperation between federal facilities and colleges and universities in both technology transfer and research and educational relationships. To the extent possible, personnel assignments should be filled by individuals on temporary assignment from federal R&D facilities or agencies (or from representative user groups) to provide both a direct emphasis on service to the federal facilities and a results-oriented focus based on recent hands-on experience in technology transfer.

A more active FLC, with dedicated rather than ad-hoc resources could make major contributions to the acceleration of present trends toward stronger federal technology transfer. It would concentrate in areas of marketing, networking and training.

Marketing - Federal technology transfer will increase directly as the demand for federal expertise and technology increases and as the commitment of federal facilities and their staffs to this process increases. Through the FLC's regional networks and increased cooperation with associations or common-interest groups, the general aware-

ness and demand can be increased. Working with federal facilities to foster more active, more expert programs will help to strengthen the resource side. These efforts can only be effective if there is a clear national mandate that can draw genuine interest and commitment from both the source and user of technology, as well as strengthen the cooperation with existing networks.

These efforts are particularly important if the benefits of technology transfer are to be pragmatically available to the areas of the nation that do not have major federal technical facilities nearby.

Networking - Improved networking will provide more efficient, effective use of each federal facility's technology and more responsive, rapid results for the user. This networking permits federal facilities to learn of the transfer methodologies used at the other facilities, and can be of significant assistance to smaller facilities and those increasing their emphasis on technology transfer. For the users, particularly those not located near major federal facilities, it provides a friendly mechanism for finding the "right" technology or expert somewhere in the federal system.

The FLC's decentralized regional structure and semi-annual meetings already provide much of this function. Dedicated support to the regional activities will significantly increase their effectiveness. Broader use of electronic mail and development of detailed, electronically-accessible, facility resource directories will be very valuable.

Other Support - Other activities of a strengthened, formal FLC would include: a) comprehensive training programs for professionals assigned to technology transfer, covering more areas than are now

addressed; b) overall coordination, management and staff support to the entire FLC function.

Encourage Effective Use of Intellectual Property

In the past, there have been instances of valuable technologies not being transferred because exclusive licenses to the governing patents were not expeditiously available. Although patents and other intellectual property do not affect the majority of transfer cases, they can be crucial in some cases. Rapid, effective licensing procedures are being developed in some agencies. These procedures should be coupled with appropriate incentives to inventors to ensure recognition and reporting of important innovations. Because the government does not have industry's flexibility in rewarding employees, royalty-sharing may be an appropriate incentive within the government. Income from patent licenses should also be used to reward noncommercial innovations and for other mission-strengthening purposes within the laboratories.

Make Technology Transfer a Part of Every Federal R&D Program

The vast majority of federal R&D activities do not place emphasis on promoting technology transfer or technical assistance. A sensitivity to potential applications of new technology, active person-to-person efforts to link users with new technology, and to link those having technical needs with expert resources, will significantly enhance the movement of technology into productive public- and private-sector uses. The expectation that some of the technical staff on each program will devote some time to active technology transfer (depending on the nature of the technology) will foster this process, particularly if the laboratory or agency requires a report on transfer activi-

ties as part of program reporting. Congressional encouragement that agencies provide identified technology transfer funds in each program and laboratory would significantly strengthen the support for this activity by the technical staff and first-line managers. This support would be strengthened further if technology transfer were a personel evaluation criterion for the professional staff and management.

Congressional Recognition and Encouragement of Laboratory Initiatives and Results

Congressional interest can be an effective motivation. They could encourage and review the Laboratory's efforts and successes in technology transfer through congressional oversight and interest from cognizant committees and from the local representative whose district includes the Laboratory. They could recognize also the extension of each laboratory's efforts through the national networking of the Federal Laboratory Consortium.

Establish a National Forum on Technology Transfer

Most public and private organizations belong to one or more common interest groups, such as the Society of Research Administrators, various industrial trade assoications, small business groups, and public-interest organizations like the US Conference of Mayors. There have been many one-to-one contacts between these organizations to develop cooperation, but there is a significant need that remains unmet: to "network the networks" i.e., to make pragmatic technology transfer the basis for a major, ongoing forum among all these organizations' members. Much of technology transfer can be attributed to serendipity, but special efforts to broaden the network of contacts and interest will help us organize for serendipity.

A series of major regional and national conferences should be convened to introduce and link representatives of federal government, university, local and state government, large and small industry, and their various common-interest associations. These links should be valuable not only in technology transfer but also in technical collaboration, education and training and other potential areas of cooperation. These meetings would be the opening steps in a continuing dialog among these groups, focused primarily on forging new cooperative efforts.

I thank you for the opportunity to present these views and suggestions.

Mr. WALGREN. Thank you very much.

I understand that Dr. Gray will have a conflict at some point coming up relatively soon, but we have a little more time on that. And I apologize for the size of the panels. It makes it a little bit difficult to get through everybody in a way that we can then have some interaction among you gentlemen.

But let's turn to Dr. Drew. And as you know, Dr. Drew, your written statement will be made part of the record without more, and please feel free to summarize or outline the points that you would really like to hit on in the way that you feel most effective.

Dr. Drew.

Mr. DREW. Thank you very much, Mr. Chairman.

I am here today, as you know, on behalf of the Institute of Electrical and Electronic Engineers. First, I think we would like to compliment the committee on sticking with this topic and continuing to pursue an issue which I guess I would like to characterize in a way that was characterized this morning in the paper by one of the columnists, quite appropriately, and if you might allow me to quote, after some discussion of this question of industrial competitiveness the comment is: "You cannot avoid thinking that these issues deserve far more attention than aid to Nicaragua, MX missiles, star wars, and other such preoccupations of the administration and Congress. They have to be at the forefront of budget, defense and tax policy," and I would add science and technology policy in the country, "where they are, quite literally, survival issues for this country." So I think what we are talking about here in terms of technology transfer is part of this overall concern for industrial competitiveness, the health of our industrial science and technology sector in the country today.

The IEEE has for some time been a very strong supporter of measures which improve technology transfer into the private sector. In so doing, we have emphasized what we felt were important private sector prerogatives, and I think in looking at several

of the measures that have been proposed to increase and provide additional incentives in the Federal structure for such technology transfer, we believe they have crossed over quite considerably into ground that we would certainly approach with a great deal of caution. And that is providing what were essentially the same sort of incentives which worked very well in the private sector but into a Federal milieu. And we believe that the problems that are associated with appropriate and effective management of Federal laboratories, which have been studied and reviewed in several significant comprehensive reviews recently, illustrate that it is indeed a challenging job to effectively direct these resources, the accomplishment of the agencies' missions in ways that keep the focus on those missions.

And we believe, therefore, that adding what are essentially commercialization objectives to these laboratories with direct financial incentives is undesirable. Nevertheless, we believe that measures such as those originally established under the Stephenson-Wydler Act are quite appropriate and should be extended. They should, in fact, be the basis for some additional program initiatives that we have dealt with in our testimony.

Let me just highlight a few of those. First of all, I think we tried to make the point that technology transfer occurs best when people are in contact. It is not an exclusively person-to-person process as you well know. It is important to have the literature base and the information in the scientific literature available, but it also, and probably more importantly, occurs when people come into contact. Therefore, we would encourage greater attention to opportunities to cause that contact to occur in settings where the roles of the individuals, in this case laboratory personnel, Federal employees, in a situation where they are not at risk can nevertheless be encouraged to conduct a dialog with those individuals in the private sector who indeed have that risk-taking environment with them every day.

I am personally a small business entrepreneur. Our business quite strongly depends upon a technology transfer it turns out between a NASA laboratory and our business. So, we are experiencing this firsthand technology transfer phenomena and have exploited it and are continuing to develop our business very strongly based upon this technology transfer function. But I can assure you that it was key to our process to have personal contact. That was terribly important, and it made much more effective the entire process in which we are currently engaged.

Therefore, I think exchange programs are terribly important to the kinds of programs that bring university and even industrial people into the laboratories for brief periods, and laboratory people out into the private sector are important. I would encourage continued use of the technical conference, symposia, the opportunities to engage in open dialog, which I think have been unfortunately chilled by some of the measures to restrict that dialog in the name of export control and other national security—quote national security—interests.

I believe that, and this, of course, strikes very close to the interests of the IEEE, that the technical conferences and the interaction which takes place at them is a terribly important part of our enter-

prise that can and does indeed lead to technology transfer, and should be encouraged, supported. The time that is necessary to do that type of preparation should be made available and welcomed in the Federal laboratory structure.

In New Mexico, a few years ago, under former Senator Schmitt there was a technology expo, if you will, in which Federal laboratories played a very major role. Those I think should be continued to encourage this firsthand contact. This type of technology display can be engaged in by the Federal laboratories very effectively, should be encouraged and expanded.

It has been mentioned that the patent policies have been changed to encourage the exclusive license arrangements particularly with small business. I can attest to the fact that without the ability to gain an exclusive license position we would not have been interested in the particular technology that we are using. So that was a vital element, and I think it was an important measure. It is not clear to me that extending it to all businesses is wise, but it certainly ought to be looked at. And I think that is an area of public policy development that might indeed broaden and encourage this practice.

Finally, let me say a positive word about the SBIR program, Public Law 97-219. I believe that that program has the potential for encouraging greater technology transfer while simultaneously providing incentives to small business development. And that is suggested in my testimony by providing an incentive, if you will, to small business entrepreneurs to reach into the Federal laboratory system for technologies which appear attractive to them. The decision should be on the part of the industrial entrepreneur, not on the part of the laboratory. The information should be available, but I think that the corrective factor which is in the risk-taking commercial enterprise sector needs to be kept in mind and to be a factor which is operating in this technology transfer equation. It must not be lost, must continue to be the sort of self-correcting factor that is present in all such operations.

Well, this summarizes, I think, the major points of my testimony. Thank you very much for this opportunity, Mr. Chairman.

[The prepared statement of Mr. Drew follows:]

Statement of
Dr. Russell C. Drew
on
Technology Transfer and the Federal Laboratories
on behalf of the
Task Force on Productivity and Innovation
of the
Institute of Electrical and Electronics Engineers
Before the House Science & Technology Committee
Subcommittee on Science, Research & Technology

May 22, 1985

Mr. Chairman:

I particularly appreciate this opportunity to provide the views of the Institute of Electrical and Electronics Engineers on the general topic of technology transfer from Government to the private sector, and specifically on the two proposed bills, H.R. 695, "To improve the transfer of technology from Government laboratories to the public...", and H.R. 1572, "To amend the Stevenson-Wydler Technology Innovation Act of 1980 for the purpose of promoting technology transfer by authorizing Government-operated laboratories to enter into cooperative R&D agreements and by establishing a Federal Laboratory Consortium for Technology Transfer within the NSF..."

Over the years, the IEEE has been supportive of Federal incentives that provide for better utilization of technology that has been developed with Federal funds. As the world's largest technical professional society, we have over 200,000 members in the U.S., largely working in the private sector. Our membership also includes Government employees and academia as well, so we enjoy a very broad outlook that arises from the interaction of these differing perspectives. Thus, our support for technology utilization is based upon a perception of national need and not to favor one sector over another.

The IEEE has also championed measures that would restore more patent rights to the individual inventor, since in many industrial settings the individual inven-

tor is required to sign away all of these rights, whether or not the invention is job related. We have taken this stand, based upon our conviction that better incentives to the individual will be a powerful motivator to stimulate innovation, which in turn will continue to generate economic growth in this nation.

Given this strong background of support for both technology transfer and better patent incentives, our opposition to the two bills cited--at least in their present form--may appear to be inconsistent with our earlier positions. I should like to make it clear at the outset that we maintain our strong support for better utilization of Federal technology and for improved individual inventor patent rights. The mechanisms that are employed in achieving these objectives, however, make a great difference. Quite simply, in our view the ends--technology transfer--do not make all of the means--particularly those which may harm the principal mission of the Federal laboratories--equally acceptable.

This is particularly true when introducing a major new element--in this case a powerful incentive--into the very large Federal laboratory system. As you know, the laboratories either perform or direct a major portion of Federally supported research and development. Quite naturally, there has been concern about the effectiveness of the utilization of the annual investment of Federal funds at these facilities. Several recent comprehensive reviews of various aspects of the Federal laboratory system have generally indicated that they have, as a whole, served the country and their sponsors well. There are improvements that can and should be introduced, but no dramatic and radical changes seem to be indicated. We have no reason to disagree with these assessments. Perhaps more importantly, we support the use of Federal laboratories, where the agency mission requires in-house, or closely tied research and development support. We also strongly support the view that such laboratories should not be in the business of competing with the private sector.

The unique and special facilities that may exist at such laboratories and the generally high quality of the people that are working there are indeed a valuable national resource. But that resource has been created, not for general-purpose technology advance, but rather to support very specific agency missions. If this is not so, then the laboratory should be abolished or transferred to the private sector.

There are very real problems associated with effective laboratory management by the sponsoring agency, and many of these problems have been detailed in the recent reviews cited earlier. It is difficult to keep the work of the laboratory well-focussed on current agency mission needs, and to provide adequate guidance from the sponsor without also becoming guilty of over-management. Thus, there is a continuing balance that must be struck between the need for close coupling of the laboratory and the avoidance of micro-management which stultifies the creativity of the people involved. The agency sponsors must continue to work hard to achieve this delicate balance.

Both of the proposed bills being considered by your subcommittee would insert new elements into the situation, by encouraging laboratory participation in commercial enterprise and providing a monetary incentive to both the laboratory management and to individual laboratory employees. Because of the concerns I have described, these measures would appear to us to be undesirable as they are currently formulated. They would have the effect of diluting the laboratory primary mission by making each of the employees more interested in commercial gain from potentially profitable inventions and by holding out to laboratory management the prospect of additional laboratory revenue from these commercial activities. There are, of course, ceilings that avoid having such activities grow to become a dominant force, but by changing the incentive system for employees, it appears that there would be great potential for harm to the per-

formance of the sponsoring agency mission. The motivation could become "does my work lead to a profitable invention?" rather than "does my work advance the sponsors' needs."

The difference is real, and it results from the introduction of monetary incentives, which can be powerful motivators. This element of the provisions of these bills should be removed.

How then, can technology transfer be encouraged more effectively? The Stevenson-Wydler legislation gave a positive boost to the process by specifying establishment of the Center for the Utilization of Federal Technology and individual Research and Technology Applications Offices in each Federal laboratory. These functional elements should be strengthened and given adequate support to carry out vigorous information dissemination programs and promotional activities that reach more extensively into the private sector. Rather than put tne laboratories into commercialization, let decisions about what has commercial potential be made by those people that are willing to take risks to bring new products and processes on line. This risk-taking atmosphere does not exist within the protected environment of a Federal laboratory and is an important element in introducing a self-correcting factor into the system.

Technology transfer occurs best when people come into contact, rather than through reading published materials. Therefore, there should be more opportunities provided for individuals to visit laboratories and to work there on an exchange basis for a limited time, both for university professors as well as industry personnel. There need to be continuing incentives given to the laboratory personnel to attend technical conferences and give papers that bring them into more frequent contact with their colleagues. There should be more laboratory participation in technology transfer-oriented shows and displays, where their fields of activity are presented in an easily absorbable form.

Current patent policies allow Federal agencies to grant exclusive licenses to small businesses that have a plan to commercialize inventions held by the Government. This policy should be exploited more vigorously in reaching out to the private sector.

Also, the encouragement of individual creativity should be preserved, consistent with the primary focus on mission-related performance. For example, it is important that individuals in the Federal laboratory system retain patent rights to inventions made on their own time, and if their work on the sponsoring agency mission results in a patent filing that is later commercialized through the processes I have outlined, there should be recognition of this achievement.

In addition, the SBIR Program provides a valuable incentive system to entrepreneurs to initiate new projects. It appears that there could be greater connection to the utilization of Federal technology in connection with this incentive. For example, it could be possible to provide additional consideration to those small businesses that would propose a project that utilized a technology from one of the Federal laboratories.

These are a few examples of ways in which the objective of increased technology transfer might be advanced, without intruding into the basic missions and incentives that drive the Federal laboratory system. We believe that it is more desirable to approach technology transfer in this way than to add new legislation.

This completes my formal statement, Mr. Chairman. I would be pleased to answer any questions that you may have.

Mr. BROWN [presiding]. Thank you very much, Dr. Drew. Do you have some questions, Mr. Lujan?

Mr. LUJAN. Just one basic one. You know we have all been involved in this whole thing and trying to find ways of doing it, and I guess, you know, the entire testimony is, you know, it depends on people. That is, personal contact between industry, universities, the laboratories, and all that.

But it occurs to me that we all do things because they are advantageous for us to do them. Whatever, I don't mean necessarily that that is the only thing that we will do, but those things that, whether we profit, whether, you know, in our business getting more votes or, you know, whatever. But I think it is a very important factor even though nobody on the panel seems to think that the 15-percent royalty to the employee is a good thing, we need to find some incentive so that not only those that—whose responsibility it is to have tech transfer are involved in it, but the leaders of the various groups within the laboratories down to the guy that operates the machine or whatever. And I think, you know, it is a question that needs a lot of thought as to what incentives we can build in. Certainly it is—the industry should be out looking for those things that they need, but if we can have some impetus from the laboratory, and if it permeates the entire laboratory system rather than just your offices, you spent a lot of time in it and you are dedicated to it. But how much work do you get from—yes, Bob?

Mr. STROMBERG. Mr. Lujan, on that question I think I've seen in the last few years that I've been in this job with the various commissions that have come through visiting Sandia Laboratories that George Dacley, our president, is very much concerned, and I have been filling him in so that he can brief the Packard Study and the Grace Commission and all the different groups that have come through, and demonstrate to them that our laboratory, in fact, has a record of successful tech transfer. And I would second Gene Stark's suggestion again and say that if Federal programs include as a part of the program the requirement that technology transfer occur, that is a strong motivation not only to the staff but also to the managers at all levels within the lab to demonstrate that, in fact, there has been performance.

Mr. LUJAN. Yes; we're going to have to run and vote.

Mr. DREW. I would certainly second your thought that individual incentives, financial incentives are a very powerful motivator. We were a little concerned that by putting those financial incentives in essentially a no loss situation, no risk basically, typically inside a laboratory using Federal funds, that you, in fact, provide a little too much incentive. We worry about whether or not the individual at the bench is worrying more about his financial payoff than perhaps the agency mission that is his primary reason for being there.

Mr. LUJAN. Well, maybe not just financial, maybe a gold star, you know, like they used to give in school, or just different methods.

Mr. DREW. Well, I think it's important to have management recognition that this is an important objective, and I think the sort of things that you have been talking about are more appropriate than I think getting down to individual financial return.

Mr. LUJAN. Yes.

Mr. BROWN. I'm going to excuse Dr. Gray, who has another appointment, but I'd like to ask you other three gentlemen if you could remain while we take a brief recess.

Dr. Gray, we wanted to ask you some questions about the technology transfer experience at the Lincoln Labs and also a little more on the polymer processing development, the success story that you relate there. I think we better ask you those in writing and have you submit some answers for the record if you don't mind.

Mr. GRAY. I would be glad to respond, Mr. Brown.

Mr. BROWN. And I apologize for the exigencies that require us to recess at this point.

The subcommittee will be in recess for about 10 minutes.

[Recess.]

Mr. BROWN. May we ask the panel members to resume their seats, and we will try and move along here despite the interruptions and other problems.

Mr. Stromberg, I wanted to ask you, if I could, if you have detected any differences inherent in the nature of some of our Federal laboratories such as the difference between a Government-owned/Government-operated and a Government-owned/contractor-operated laboratory. Is there anything intrinsic in having a privately-operated—contractor-operated facility, as in the case of Sandia, which is a contractor with a strong base in the private sector? Has that facilitated the excellent record that you have described there due to that particular characteristic, or is it merely the fact that you've worked extra hard there and a Government-owned/Government-operated facility lab could do the same job if it worked as hard as you do there?

Mr. STROMBERG. Well, I'm pleased you asked that question. I don't think people are different because of the fact that they're set down under a Government-operated/Government-owned lab or set down in the contractor-operated lab. It seems to me people are different, and I think somehow we've created a situation where the motivations may be different by the way in which things have been structured. Our lab was set up and was very clearly established on the assumption that it would be like an industrial place and, of course, industry insists on making use of their valuable commodities when they acquire them. So I think a culture that insists that things that are developed in our research group be, in fact, not transferred up the line for production within the private company but in our sense be transferred out to some industrial company, you know, that culture is there.

For civil service labs I think perhaps the problem is the lack of, as I heard Mr. Michael talk yesterday, the lack of a really clear merit structure that, in fact, makes it clear to the people working in an environment like ours that they'll be rewarded with promotion and with respect and with more money because, in fact, they demonstrate that part of their performance is tech transfer. You know, a merit system that actually worked in the civil service labs would be a marvelous thing. But as I mentioned in the testimony, I get the feeling that's an extremely difficult thing to carry out, but there can be means by which people can be made to recognize that as a part of their function.

I recognize, also, the comments from the IEEE people, that along with that comes that conflict of interest difficulty that has to be addressed, and that's very real.

Mr. BROWN. Well, all of you, or all of the witnesses, and I think Dr. Drew indicated the same thing, focused a great deal on the individual interaction as being the key component. Dr. Gray suggested that their success at M.I.T. stems from the fact that they've provided a culture and an opportunity in an institutional setting in which there could be this interaction between the basic researchers and the people from industry, and that that was the key to success, and you've emphasized the same thing.

But there is a difference not only between labs but between institutions. M.I.T. was set up with a charter which emphasized serving the business and industrial needs of the community, and its whole pattern of development has placed a strong focus on that, and that's not to derogate its strength in basic research. It is very strong there, also. But it was never schizophrenic about the fact that it ought to seek ways to interact with the needs of the worldly community, and it's done an excellent job of that. Others don't have quite the same mandate.

Other labs, and you could look at Sandia and Los Alamos, they have different personalities. They have a different structure of employment. You have a greater emphasis on engineers, Los Alamos on physicists and mathematicians probably, and that makes a substantial difference.

Mr. STROMBERG. I guess I would just add, Mr. Chairman, I think it really comes down to the means by which people are motivated. I think that's really what we're speaking of, is how do you motivate a group of people so that they will, in fact, take those person-to-person actions that, in fact, cause the transfer to occur.

As a side comment, when I was in Japan I was struck by the fact that those folks are motivated over there, let me tell you. They're hungry. You don't see people having coffee breaks over there, they're at it all day long.

Mr. BROWN. Do you think that's a superiority not to have coffee breaks? [Laughter.]

Mr. STROMBERG. No; I just simply make the point that, whereas in the American culture you see people taking breaks all the time, I was struck by the fact that there's a strong motivation to, in fact, carry out the purpose. It's like the new young boxer and the champion. I was struck by that difference.

Mr. BROWN. Well, in years past the witnesses trying to emphasize the difference between the two cultures have given the example that they had witnessed the Japanese running to the bathroom and running back as an indication of their high motivation. I'm——

Mr. DREW. Certainly running back would. [Laughter.]

Mr. BROWN. I'm not yet convinced that that's an indelible mark of superiority in their system. [Laughter.]

Mr. BROWN. Dr. Drew, you point out the importance of the individual incentive, but you focus your attention more on the need to provide the individual with the rewards of his creativity through some benefits from patents that may be developed by the individual scientist or engineer, and obviously that is a way to provide in-

centive for the technology because in that way, with the individual receiving the benefits from the commercial development, he would be highly motivated I would think to seek ways in which it could be commercially developed.

Mr. DREW. Yes, Mr. Chairman, I wanted to make sure that you understood our cautionary concerns about that. We're on record in many forums and have sponsored legislation to provide stronger benefits to the individual inventor. As you know, many industrial firms tie up the creativity of their employees whether they're working on Saturday in their garage or whether they're working on the job. We think these kind of incentives are powerful motivators and should be, as a general public policy matter in the United States, encouraged and utilized.

In the Federal laboratory setting, however, I think we'd feel more comfortable with a process which rewarded creativity not so much in direct response to, say, some royalties returned, but perhaps as I understand how NASA operates, and that is to reward creativity whether or not it has direct commercial application.

I mean, I guess we wanted to refocus attention on why these laboratories exist. They exist because it's a principal mission, and we don't think that mission should ever be subverted by others which may be layered in on top of them. You can reach in and encourage this, but I think it has to be done, we said with a certain degree of delicacy, so that you don't insert too much of this commercialization incentive.

Frankly, you know, the things that are happening as I understand it around Los Alamos and Sandia, in fact, I guess they're happening in many cases around Federal laboratories, is an entrepreneurial climate where there are small businesses and people growing up outside the gate with the availability of some sort of financial backing, risk capital if you will, provides an awfully good incentive. People find ways of getting into that community, and that kind of climate which has I think been stimulated by a number of measures over the past 4 or 5 years is having, I think, a very beneficial effect; probably stronger than any of these measures would.

Mr. BROWN. Yes. Well, we're not going to let your antipathy toward these measures discourage us completely, but we will examine them more closely.

Now I want to explore one further matter with particularly the two of you who are in the Federal laboratories. We have been seeking for several years in this subcommittee, and the Congress has enacted some of these provisions—ways to make the technology transfer, discipline or whatever you want to call it, more respectable.

And we have had testimonies going back for years that you had to provide professionals ladders of advancement here, adequate compensation, recognition of the importance of the job and many ways the opportunity for enhanced communication, both with the community and with other laboratories. We don't seem to have reached overwhelming success in achieving that as yet, but would you gentlemen say that we are making progress or that we are not making progress, or that we are moving backward in regard to that?

Mr. STARK. I think I would say that we are making important progress in that area because simply as the laboratories and agencies placed more emphasis on technology transfer, quite naturally there is greater professional motivation and greater possibility of competition for the job functions of technology transfer within the Federal labs. And quite frankly, a greater possibility for assignment of outstanding individuals to those assignments.

Mr. BROWN. Now, I want to discuss with you for a moment the Federal Laboratory Consortium. Both of you have indicated the fact that you feel that it needs to have a stronger mandate, and it needs to have a home, a sympathetic organizational local. And I think both of you suggested the National Science Foundation.

There is a problem with that, and there always has been a problem with it in that the process of technology transfer, and particularly the latter stages where it leads to commercial development, have never been seen as an integral part of the function of the National Science Foundation, creating the climate within which this could happen, possibly so, supporting demonstrations of the best way to achieve this, yes. But in terms of a permanent organizational structure for an ongoing process, I think that it would be looked upon as not being entirely appropriate.

On the other hand, we have looked at the role of the Department of Commerce, the Center for the Utilization of Federal Technology, other sites there, as possibly being appropriate, but the administration doesn't seem to look with great favor upon carrying it out in that kind of a situation. And that leaves me with a question of what we can do to provide the Federal Laboratory Consortium with that kind of a desirable supportive environment that they could develop a little stability in.

I would like to have each of you discuss for just a moment some of the other alternatives that you might see in the possibilities of a successful operation outside of the National Science Foundation, or if you feel that this is absolutely the best possible world for the consortium, try and justify that to me a little bit.

Mr. STARK. I guess I would comment that I see the National Science Foundation as the ideal place for the Federal Lab Consortium. And my argument, I think, would be that the Federal Lab Consortium for technology transfer does not, itself, transfer technology. What we try to do is help the laboratories do a better job by allowing them to network among themselves, and by helping to establish relationships and contacts between the laboratories on the one side and the users of technology on the other side.

And therefore we are not asking in any way that the NSF be asked to manage the process of commercialization, but rather to provide an organizational home for the interagency, interlaboratory cooperation on the methods and networking of technology transfer, and again, leave it to the individual labs and agencies to develop their own best methods for transfer and use this networking process to transfer the methodologies, if you will, from what works in one lab and one agency to the appropriate modifications to those methods in other labs and other agencies.

Mr. STROMBERG. I find that what Gene Stark just said is pretty much what I would say also. I would simply add I think that because we have such a large governmental structure, we find we are

very separate in the different organizations, because we are way down the line in terms of the structure. The bright people in these groups simply saw the obvious need to come together in a network, but not necessarily to try to restructure a new tightly managed organization in any sense.

And so the networking, the allowing of communications, and in allowing people to exchange their best methods for interaction is the function we are looking for here, not another structure that somehow operates with any strong mandate across all the different executive agencies. So it seems to me that we need a place where that kind of cooperative effort can go on. It would strike me that NSF is a fairly decent place for it. And as Gene had pointed out, we would suggest that the staffing be rotated, perhaps, from staff within the labs in order that, as he mentioned, it not grow into another dominant and controlling kind of agency trying to, direct these labs, tech transfer efforts.

Mr. BROWN. Well, I would agree with you it would be ideal in a number of ways. It is an independent organization of high professional status, well-regarded, neutral in terms of the mission agenices in which the labs actually exist—or presumably neutral—and having some advantage from that standpoint. But the missing ingredient is high motivation to engage in this kind of activity which might be a serious problem, but insurmountable. And I appreciate your comments on that.

The problem of networking, of enhancing communication through computer systems, am I correct that you don't feel that the laboratories are adequately networked at the present time?

Mr. STROMBERG. No, that is really not true. You see, what has happened up to date, is there had been one other previous experiment by the NSF people, and then starting about a year and a half ago, our laboratory has an electronic mail system that I was able to offer to about 35 people who are, in fact, on that network. But at our laboratory we really can't extend it to the entire 200 members, nor can we see to it that some of the difficulties with phone line communications are straightened out.

But there are some tremendous advantages to that system as far as the convenience of seeing to it that a person who requests information gets the best. For instance, he might come to Sandia and ask for biotech information, an area in which none of our people work. There is a difficulty for me and for the rest of us keeping a record as to who currently has information and what labs are currently working in particular subject. But if through an electronic mail networking that question can be brought to the attention of the entire membership, we can have instantaneous and very efficient reaction and see to it that the best laboratory is found and the best people are made available.

And it really works. As I mentioned, we have a couple of cases where the best information was obtained in less than 2 hours. One case in Minnesota, I think, is interesting where a person was looking for information on electroluminescence. We made a request of a gentlemen at Argonne National Laboratories. Jim Wyckoff from the Bureau of Standards responded within 2 hours by giving the right information back to that person.

The system is really very efficient and can be done with a small amount of time on the part of each of us who are tech transfer officers, too.

Mr. BROWN. Well, I would like to pursue some of this further, but time will not allow that. I want to thank all of you for your help here this morning, and we will be in touch with you for further information in writing if we need it.

We now have our distinguished colleague, Congressman Ed Zschau from the great State of California who is unique amongst the Members of Congress in his own experience and background in the technological field. And we are happy to have you here this morning, Mr. Zschau, for your testimony.

STATEMENT OF HON. ED ZSCHAU, A REPRESENTATIVE IN CONGRESS FROM THE STATE OF CALIFORNIA

Mr. ZSCHAU. Thank you very much. Mr. Chairman, I have a prepared statement which I would like to be included in the record.

Mr. BROWN. Without objection, that will be included.

Mr. ZSCHAU. In the brief time I have here, I will just summarize some of the highlights of that I am delighted to have the chance to testify on H.R. 695 and H.R. 1572. The basic question that these bills address is how to get the greatest value out of the R&D expenditures and activities in our Federal laboratories.

I am one of those who believes that the Federal laboratories that we have in place constitute a national resource, a very important asset to this country. But whenever you have a resource like this that is so valuable and so capable, you must always be asking the question: How do we get the full value of that resource? It seems to me that there are three questions or objectives, I should say, that have to be addressed when one asks that question.

First, how do you make sure that the research that is conducted in the laboratories is useful and relevant and will have value to this country and its people? Two, how do we make the work in the laboratories as efficient and effective as possible, addressing the productivity issue? Three, how do we transfer to commercialization and application the results that come from this research?

I have the privilege of chairing the Republican Task Force on High Technology Initiatives. One of our objectives this year is to study this question and how to address these three objectives. In the course of that study, we consulted with about 50 experts outside the Congress in academia, in laboratories and in the private sector. The results of their opinions have not come to any conclusive conclusion.

They have mixed perspectives on the issue. One of the questions that they raise was the even more fundamental question, which is, Have the Federal laboratories outlived their usefulnesss? Is it important that we have as a nation a system of Federal laboratories, or should we be looking to privatize some or consolidate some or change their missions? I would recommend to this committee that in addition to the questions that we are addressing here about how to make this resource more valuable, that we also ask the more fundamental question: Is this the proper way to organize our R&D expenditures?

As the chairman has pointed out, I come from California. I represent the Silicon Valley which has had an excellent record of technology development. Many people try to understand how that has occurred. They ask me: What are the secrets to Silicon Valley? I am told that these secrets are going to be revealed in the near future. One of the major television networks, I am told, is going to have a soap opera about Silicon Valley. This soap opera, according to advanced notice, purports to tell in intimate detail the story of technology and lust.

So we may find out the secret soon. Let me just say from personal experience that even though the Silicon Valley area may be competitive when it comes to technology, it doesn't appear to be, at least from my vantage point, competitive to a place like Washington, DC, when it comes to lust. But when the story of Silicon Valley is really told, it is not going to be a story of technology or apparatus or laboratories or lust. It is the story of people.

It is a story of people—entrepreneurs, inventors, innovators, people with vision, people who work together because most of these projects are not done singlehandedly, people taking risks, people trying new ideas. It is the environment, which has really created Silicon Valley, an environment that encourages those kinds of activities by people.

It seems to me that because the thrust of this legislation is to create such an environment in the Federal laboratories, that it is highly appropriate. It is designed to do this in two ways: First, to promote cooperative relationships with industry so that we can get higher leverage on the Federal dollars that are spent by adding to those private sector dollars and to make sure that the research is relevant to issues that the private sector is really concerned about. Through these cooperative relationships and the interchange of information and viewpoints, the relevancy of the research, I think, can be enhanced. They also facilitate the transfer of the research and the developments from the laboratory to the private sector. If you are working together throughout the whole process, the transfer is much easier than if the research is done in a vacuum and then you try to transfer it to the private sector.

So the emphasis of those cooperative relationships, I think, will help to enhance the environment that will increase the usefulness and relevancy, as well as the technology transfer of the laboratory's activities. I think it is going to take time, however. A point was made here earlier, as I was listening, that companies in the United States aren't flocking to the Federal laboratories, knocking on the door and asking for answers to their questions. Although foreign companies may be doing this, U.S. companies have not.

I think it will take some time to develop the mutual respect that will be the foundation for successful cooperative relationships. But I think that can be done. It is going to take some outreach by the labs, but over time and through the success of some projects, I believe it can happen.

Second, these pieces of legislation try to create an environment for risk-taking and relevancy of research by sharing royalties with the inventors and the laboratories. This will tend to focus the energies of research personnel on projects which do have a commercial value which can result in royalities, and also enhance the transfer

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as well. Having been president of a high technology company, I know that one of the things that inventors least like to do is file patent applications. That is sort of the hassle that you have to do if you have been a successful inventor, working with those attorneys and going through all of the disclosures and depositions associated with filing patents. But if there is a pot of gold at the end; that is, if there is an opportunity to share in the royalties from the success of patented activities, the incentives to do that kind of thing will be increased.

I think also that it will provide incentives for new ideas. People who can get a piece of the action tend to try new things and to be more innovative.

I support, in general, the thrust of those two attempts to increase the value of the laboratories' cooperative relationships on the one hand, and royalty sharing on the other.

However, I have a couple of caveats to that support. First, I am concerned, as it was mentioned here earlier that this could result in a short-term orientation to the laboratory research. Although that is good in terms of getting commercialization of ideas, we also have to make sure that we have a foundation of research that provides the basis for future products and technologies and on going investigation of how the world works. I think that research management, good research management, in the labs can provide a balance here, but I would just point out that is one of the concerns I have that the laboratory research becomes too short-term oriented, and doesn't deal with some of the longer range issues.

Second, I think there is a real risk that situations can develop in which the compensation, the specific reseachers would be labeled unfair by their colleagues. This can be a management problem. It can be a management problem because, if the incentives for doing commercial research become so great, management can have difficulty in directing the laboratory personnel to projects that may not have such a short-term orientation or may not result directly in royalty.

It can provide some pressures that management would have to deal with. But I think more important than that, it is possible that such compensation schemes, and here I am referring to the giving of 15 percent of the royalty to the inventory, can interfere with the team work and the communication that is so necessary in modern research activities.

I have a couple of examples from my own business in which I provided such incentives, and where it came back to bite me.

In one case, there was a patented invention in which two of the people in my company had a share of the royalties. The people who had to support them in making this a commercial product did not receive a share of the royalties. The way the whole situation worked out, we paid well over a million dollars to a couple of people for an invention that never was a commercial success for our company. The way in which the royalty deal was constructed, it was based on sales. We got lots of sales, but we didn't get the profits. As a result, the people who were working on that team began to resent the fact that here was something that was not being successful for the company, in which they had stock and stock options, but two of their colleagues working side by side from

them were getting compensated anyway. It resulted in an interpersonal problem and a management problem.

I tried special bonuses in other cases and found the same thing. People who were on the projects that got the special bonuses were very happy. People who were on other very important projects, but for which bonuses were not deemed to be important or payable, were resentful. I just point that out as a caveat that this can result in situations that can cause management problems and maybe interfere with the team work and communication in the laboratory.

How do we deal with that? I think the way to deal with it, rather than throwing the baby out with bath water and saying that this is a bad idea, is to build in some flexibility, some flexibility not only in the way that cooperative agreements are negotiated, but also flexibility in the incentive program. For some inventions, 15 percent royality may be far too low. For others it may be far too high—the 15 percent share of the royalty, I should say. It seems to me that rather than stating in advance what share an inventor is going to get of the total royalty scheme, there should be some range or some ability of the laboratory manager to adjust it depending upon the situation as it arises.

Second, I think that we ought to for any program like this that we institute, have some sort of an oversight and review process so that we can determine what the effects are, and if there have been deleterious effects, changes can be made in the legislation.

I would say in conclusion, Mr. Chairman, that I support the objectives of these bills to improve the relevance, usefulness of the research, to improve the productivity of laboratory personnel, to improve the facilitation of technology transfer. I think they go at it the right way; that is, to create incentives for the private sector to work with Federal labs and for Federal laboratory personnel to be more innovative and to transfer relevant technology.

There are some problems—the short-termed orientation and the possibility of unfair compensation—but I think with proper crafting of the legislation those can be dealt with. I would be supportive of an approach to move these pieces of legislation ahead with some flexibility built in. I would also add in final conclusion that as we move ahead on this, we should also study the more fundamental question—analyzing whether Federal labs, as they are currently organized, are cost effective or whether some more fundamental changes should be made.

[The prepared statement of Mr. Zschau follows:]

A STATEMENT BY

ED ZSCHAU

MEMBER OF CONGRESS

BEFORE THE

SUBCOMMITTEE ON SCIENCE, RESEARCH, AND TECHNOLOGY

MAY 22, 1985

on

Improving Productivity in Federal Laboratories

Mr. Chairman, thank you for the opportunity to testify on the provisions in H.R. 695, the Federal Technology Utilization Act, and H.R. 1572, the Federal Science and Technology Transfer Act. I welcome the chance to express my views on improving technology transfer from the Government laboratories to the private sector. While improving technology transfer is an important issue in discussing federal laboratory programs, a more important objective is improving the productivity of federal laboratories. H.R. 695 and H.R. 1572 would help accomplish this objective.

Improving the productivity of federal laboratories means getting better value for the federal research dollar. The federal laboratories are a tremendous national resource and a valuable national asset, but also a very expensive effort to support. In the face of rising deficits and cutbacks in government spending, we need to eliminate research programs that have fulfilled their mission and concentrate on essential research priorities. We have to be certain that the federal

laboratories are still working on the sort of vital and necessary research that they were established to perform and that lab employees have sufficient incentives to perform to the best of their ability.

The Republican Task Force on High Technology Initiatives, which I chair, will be considering this issue in depth this year. We have asked over 50 leaders and experts in science and technology policy from government, the private sector and academia for their views about the role of federal laboratories in the innovation process in the United States. We found a lack of consensus among the responses about whether the labs perform activities that are useful to the private sector, and a lack of consensus about the future mission and purpose of the labs. Several respondents suggested that many labs had outlived their usefulness and should be closed or sold to the private sector.

At the same time, a vast majority of respondents supported the concepts embodied in H.R. 695 and H.R. 1572 as ways in which federal lab productivity and usefulness might be improved. The Task Force will soon publish a legislative agenda which will propose an initiative consistent with the provisions in these bills. However, the message we received from our experts--which I convey to the committee--is that we should re-examine the premises behind the existence of all federal labs to insure that the work they perform is relevant to the economic and national security needs of our nation today and in the years ahead.

I feel that federal laboratory programs should be guided by economic forces similar to those that help direct private sector

research into the most useful and relevant areas. H.R. 695 and H.R. 1572 provide for two new incentives to help direct and improve federal research efforts. The first would permit federal laboratories to enter into cooperative R & D agreements with the private sector similar to the joint research arrangements often made by universities and private firms. The second would establish new incentives for the federal laboratory scientists to perform innovative and relevant research through distribution of the patent royalties received by federal agencies.

Joint R & D agreements between industry and the government laboratories are an effective way of stretching the federal investment dollar in research and promoting better communication and coordination with the potential users of the technology. These agreements provide for a better utilization of federal dollars by allowing more private sector input and influence in the direction of the research efforts. Since the technology users would be a part of the research effort, fewer research dollars would be directed into projects that are not useful and relevant to industry. The transfer of the technology into practice would also be enhanced because the users would be directly involved in its development. There would be no lapse time or extra effort required to adapt the laboratory results to private sector application.

The second incentive that H.R. 695 and H.R. 1572 provide to improve research at the federal laboratories would encourage laboratory scientists and engineers to perform the most useful and relevant research. Allowing the federal laboratories to keep the royalties received from licensing agreements of technology

they developed would incorporate a private sector-type of incentive to the federal research programs. It would also provide the labs with an additional source of revenue at no expense to taxpayers at a time when Congress is freezing and cutting many lab programs. Most of all, it would give the inventors and developers a stake in the success or failure of their research projects. People always work harder if they have "a piece of the action."

This provision in the bills will also improve the environment for research innovation by providing incentives to exploit the technology once it has been discovered. Success in the private sector depends upon the ability to exploit research efforts and this helps focus research into the most essential areas. Providing a similar incentive in the federal laboratories will promote better utilization of the research dollar investment just as it does in the private sector.

It's important to keep in mind, however, that this type of an incentive program must be carefully crafted to avoid certain areas of potential abuse and problems associated with an atmosphere of increased competition and reward. For example, if the incentive for commercialization is too great, the focus of research efforts within a particular laboratory might be shifted entirely into short-term applications. However, those problems can be minimized by balanced research management and careful application of the incentives.

H.R. 695 and H.R. 1572 allow 15% of the royalties or other income received each year by a laboratory from any invention to be paid to the inventor(s). The remaining 85% of the royalties

up to a limit of 5% of the laboratory's yearly budget are retained by the laboratory for mission related research or incentive rewards to other laboratory employees. The 15% paid to the inventor could be a significant reward if an invention became a huge commercial success. Universities have found such royalty sharing to be a powerful incentive for inventors to contribute to commercialization efforts.

Under certain circumstances the 15% share for the inventors may not be appropriate. In some cases a higher share might be appropriate; in others a lower fraction of the royalties to the inventor would be fair. I recommend that the Committee consider putting some flexibility in the percentage of royalties allocated to the inventor(s) and to the lab's budget. Over time, the Committee could monitor the performance of this new incentive and make adjustments accordingly.

I look forward to working with you, Mr. Chairman, and the Committee toward the enactment of legislation aimed at improving technology transfer and productivity in the federal laboratories. In addition to this legislation, I encourage the committee to probe in greater depth the issue of whether the mission and purpose of the federal laboratories could be improved and include in its study analysis of whether some laboratories should be closed, consolidated, or privatized.

Mr. BROWN. Thank you very much, Mr. Zschau.

Mr. Bruce, do you have any questions.

Mr. BRUCE. I just wonder, Mr. Zschau, in your private life, did you ever have a chance to deal with the Federal labs in any way to develop any products?

Mr. ZSCHAU. Never. And that may be a lack of knowledge on my part—or resulted from a lack of knowledge on my part of what the Federal labs do, what resources might be available, what programs of working together there might be. Small companies—I should add mine started out very small. It employs about 800 people now. It is a public company that continues to exist. Small companies, as they are growing, tend not to want to deal with the Government. That that can often be a bottomless pit, and you just don't have the overhead to enter into relationships with other companies, and particularly an operation as large and as complex as the Government. So there wasn't a knowledge on our part, and probably if there had been knowledge, we would have been reluctant to enter into relationships like that.

Mr. BRUCE. Thank you, Mr. Chairman.

Mr. BROWN. Mr. Zschau, your contribution is extremely important to us here. We have been grappling with this problem of getting the most productivity—the most benefit for the public out of our labs for quite a few years. It almost always has been done on a bipartisan basis. We haven't always succeeded, but we keep trying.

It may be some of the initiatives proposed in this legislation are taking off a point for some further improvements, but we will not be able to get them successfully passed into law unless we do have strong bipartisan cooperation to do that. And I think you can help us a great deal in that regard.

With regard to the productivity of the labs issue, that was the subject of a study by the Packard Committee. That was not as extensive a study as I would have liked. As much as I respect the members of that committee and their own personal experience with the lab, they did not make an exhaustive analysis of the laboratories. And I am wondering whether we ought not to have some continuing process to analyze this productivity question, say, a review every 5 years on some systemmatic basis or something of that sort.

Do you think something like that would be feasible?

Mr. ZSCHAU. Well, it is not only feasible, but it is desirable. Frankly, I think it should be part of any good laboratory management system; that the laboratory managers and then the people to whom they report should be evaluating their performance. Oftentimes in R&D—these are not in the successful R&D operations, but oftentimes in R&D—you measure your success by how many people you have or how many papers you write or how many dollars you have been allocated. But it seems to me that we ought to be looking at the productivity in terms of useful results and how those results have been incorporated into the commercial sector or applied to national security issues or other issues of importance to America.

Mr. BROWN. Now, you focused on enhancing the cooperative relationship between the labs and the industry. There is another element in the equation here, and we have kind of made a cliche out

of stressing the significance of a more cooperative interaction between the university research base, the Federal Government research base, and the industry research base.

You are not trying to preclude the enhancement of improved cooperation in the other third of the triangle here, are you, but between the labs and the universities.

Mr. ZSCHAU. No, absolutely not. As a matter of fact, it seems to me that the more kind of cooperative relationships you have, the greater leverage you get on the research that is being done. One of the difficulties of conducting research in the modern world where there are so many disciplines that apply to making successful progress, is that you have to communicate with lots of different people.

There have been some successful, academic-industry joint ventures started recently in California, one at Stanford University in microelectronics, another, the University of California. It would seem to me that that model and the Federal lab model and then sort of the triangle model should all be pursued. We really should look at our research personnel as a national resource and try to create environments in which those personnel can be as productive as possible without having arbitrary barriers between Federal employees, private sector employees, and academics.

Mr. BROWN. One last question. On the preceding panel, several of the members placed considerable emphasis on enhancing the status and capability of the Federal Laboratory Consortium. Suggestions were made that it needed a permanent home to sort of give it a little bit more of a footing within the bureaucratic structure, and that we need to continue to look at ways of enhancing the processes of communication between the labs and other networks with which they might interact.

That is compatible with your views, is it not?

Mr. ZSCHAU. Yes, although I should say that as I understand it—and I am not an expert on the details of how that relationship works—as I understand it, today we have an informal mechanism of communication that appears to be working. I always go along with the notion that if ain't broke, don't fix it. If I could be persuaded that formalizing it and funding it and making it more bureaucratic would enhance its ability to function. I could support such a thing. I guess I would be asking the question, what is wrong with it now and would that proposal actually make it better.

Mr. BROWN. Well, that certainly is a legitimate point of view to take. And we will look at it very carefully from that standpoint.

Thank you very much for your testimony, Mr. Zschau.

Mr. BROWN. Our last panel this morning is composed of several distinguished gentlemen, Dr. Orville Bentley, Assistant Secretary of Agriculture for Science and Education; Mr. Isaac Gillam, Assistant Administrator of Commercial Programs for NASA; Col. Donald Carter, Acting Deputy Under Secretary of Defense for Research and Advanced Technology; and Antoinette Joseph, Director of the Office of Field Operations Management for the Department of Energy. Can we have these people come up? Don't be bashful.

Each of you have had extensive experience with regard to the administration of Federal laboratories and research facilities and the transfer of technology in many different ways. And we look for-

ward to your contribution to this hearing his morning. I would like to hear from you, I guess, in the order in which we called your names.

Dr. Bentley, you may proceed first and tell us what a wonderful system we have in the Department of Agriculture.

ORVILLE G. BENTLEY, ASSISTANT SECRETARY OF SCIENCE AND EDUCATION, DEPARTMENT OF AGRICULTURE; ISAAC GILLAM, IV, ASSISTANT ADMINISTRATOR OF COMMERCIAL PROGRAMS, NASA; COL. DONALD I. CARTER, ACTING DEPUTY UNDER SECRETARY OF DEFENSE FOR RESEARCH AND ADVANCED TECHNOLOGY, DEPARTMENT OF DEFENSE; AND ANTOINETTE JOSEPH, DIRECTOR OF FIELD OPERATIONS MANAGEMENT, OFFICE OF ENERGY RESEARCH, DEPARTMENT OF ENERGY

Mr. BENTLEY. I would be pleased to. Mr. Chairman, members of the committee, I appreciate the opportunity to be here to talk about the issue of technology transfer. I have, Mr. Chairman, a statement that has been submitted and I hope will be made a part of the record.

Mr. BROWN. It will be made a part of the record.

Mr. BENTLEY. I would like the opportunity to make a few comments. I'll start by one of the things that I think has been brought up in the earlier conversations here that I have listened to this morning, Mr. Chairman, and that is the commitment of the Department and of the Assistant Secretary for Science and Education to the matter of transfer of research-based knowledge and the utilization of these resources to create innovation and change in our system, whether that information comes from the Federal laboratories or the university laboratories, because this, we think, and I think, personally is a very important function of science and of education in our system.

We have taken this responsibility as important, and it has been a tradition in the Department of Agriculture to gather information and to help and facilitate the translation or the transfer of that information to food and fiber industries so that they might use it to answer problems—to solve problems rather, and to utilize that knowledge in the development of new technology and change. That has been one of the longstanding traditions of agriculture and often when they refer to science and technology in agriculture it is stated that the industry is developed based upon utilization of knowledge and that the future is likely to be greatly influenced by the level of scientific input and technological innovation.

Now, I want to speak a bit about some functions that have been going on in the Department or under the auspices of the Department for a long time, and I first want to refer to the Extension Service. It is in a sense an education arm of the USDA, and it is working through the State Cooperative Extension Services. It provides an established, regularized mechanism for transfer of research-based information and new technology that had been developed either in the State agricultural experiment stations or the land grant college system, the Federal laboratories and other sources of expertise. And I want to stress this point. It includes pro-

ducers, farmers, ranchers, processors, members of the marketing system, and consumers.

But we want to point out, though, that the Extension Service is not the only avenue for information transfer. The Agricultural Research Service, the State agricultural experiment stations have direct linkages to users of information as well. As a part of our scientific process, ARS scientists communicate freely what there appears throughout the world by publishing their findings or in specialized technical journals, reporting them at meetings or through direct contacts.

Beyond the science community itself, they make direct application of technology as derived from the research that we carry on. And that includes, as I pointed out earlier, transfer to all of the people that are part of the food and agricultural chain. The scientists and the Agricultural Research Service, for example, in 1984 it is estimated there were some 61,000 contacts with key user groups, and again includes the whole spectrum of organizations that utilizes information both in the public and private sectors.

This represents about 35 staff years of time or about 3 to 4 percent of the scientists' time. I want to add here that in the current system of peer group evaluation of scientists and program leaders in the Agricultural Research Service, one of the elements is the matter of the technology transfer and their role and effectiveness of that role in achieving that particular purpose.

Some examples of where were worked on collaborative basis in technology transfer from the Federal laboratories to the nonagricultural sector are represented by the arrangements that were worked out on a joint basis with commercial firms in the production and in the development of the hoof and mouth vaccine—vaccine for hoof and mouth disease and avian coccidiosis. These are in the area of biotechnology, but certainly represent an important way for us to achieve that particular goal.

In 1984 the new Office of Cooperative Interactions in ARS was formed. This office reports directly to the Administrator and serves as a focal point for the technology transfer and related activities. It also includes the functions of the ORTA, the Office of Research Technology Applications as prescribed in Public Law 96-480. In 1984 the ARS issued a publication entitled, "Agricultural Research Service Technology Transfer Plan." And this has been most useful in communicating not only to the people outside of the system, but within the system as well.

The patent policy of ARS is structured to encourage and support exclusive licensing which increases the incentive for agri-business firms to commercialize ARS technology. The National Technical Information Service handles ARS exclusive licenses and forwards royalties to the Treasury.

We have been active in the Invention Awards Program that attempts to recognize and reward employees that have made contributions in this area. And we hope that these events will respond to the legislative mandate that has been developed through various laws of the past few years.

The Secretary of Agriculture has taken some special initiatives. And one that I think fits into this framework is the challenge forum that was sponsored on new uses for agricultural products in

the USDA in October of 1984. The purpose of that form was to stimulate public/partnerships among industry associations, publishing, academia, and the Government to promote the development of new products uses and new markets.

We think that this is the type of effort that is helpful in the communication process, but more importantly in trying to develop an environment in which there is an easy and rapid exchange of information. We hope to continue these kinds of activities as a part of our research, education, extension programming and so forth that come under the jurisdiction of the Department of Agriculture.

I think, too, it is appropriate to note that one of the traditions of the development of agricultural research in education has been this strong relationship clientele-industry-laboratory relationship. And we think that this provides a good platform for expanding activities to meet the needs of the future. Thank you, Mr. Chairman.

[The prepared statement of Mr. Bentley follows:]

STATEMENT OF

ORVILLE G. BENTLEY

ASSISTANT SECRETARY

SCIENCE AND EDUCATION

U. S. DEPARTMENT OF AGRICULTURE

Mr. Chairman and Members of the Subcommittee, I appreciate the opportunity to be with you today to discuss the issue of technology transfer. As the Assistant Secretary of Agriculture representing Science and Education, I am convinced that the expeditious transfer of research-based knowledge and technological innovations developed in federal and university laboratories to practical use for the benefit of people and our economy is an important role for the USDA. We are keenly aware of the relationship between the scientific development and technological innovation and the future of our economy and the well-being of our people. We view the development of new knowledge and technology as important responsibilities of our science and education agencies, and the Secretary is strongly committed to this mission.

The USDA has a long tradition of supporting programs for gathering and disseminating information on a wide range of subjects related to agriculture and the food and fiber industries. Moreover, the Department programs are strongly oriented toward service with a strong emphasis on problem solving and development especially for rural America.

Mr. Chairman, the Department focuses substantial efforts on the transfer of technology or dissemination of research results to the private sector. I am sure you are well aware of the activities of the Extension Service. The Extension Service is designated the "educational arm" of USDA and, through the State Cooperative Extension Services, provides one route for the transfer of research-based information and new technology developed in the state agricultural experiment stations of the land-grant university system, federal laboratories, and other sources of expertise to producers (farmers and ranchers), processors, the market system and consumers.

But the Extension Service is not the only avenue for information or technology transfer. The Agricultural Research Service (ARS) and the State Agricultural Experiment Stations (SAES) have direct linkages to information users as well. As part of the customary scientific process, ARS scientists communicate freely with their peers worldwide by publishing their findings in specialized technical journals and reporting them at meetings of technical societies. Such publications and reports present the research for scrutiny and evaluation by the scientific community at large and make the results available so other researchers can expand and build upon them.

Beyond the pure scientific community are the public entities who make more direct practical application of technology derived from ARS and SAES research. These include farmers and ranchers, manufacturers and suppliers of farm inputs, industries that store, process, transport, and market agricultural commodities, national, State, and local regulatory agencies and governments, and the ultimate users--consumers.

ARS scientists have traditionally been the major force for transfer of technology acquired in Federal research programs to prospective end users and organizations such as Extension, which assist in the transfer process. In 1984, for example, ARS scientists made more than 61,000 contacts with key user groups including industry firms, farmers and ranchers, state and local governments, consumer groups, action and regulatory agencies and others. This represented 85 staff-years or 3-4 percent of scientists' time.

In recent years, it has been our goal to improve the technology transfer from Federal laboratories to the agricultural and non-agricultural industrial sector. One avenue is through development of joint research arrangements with commercial firms such as those which successfully produced vaccines for hoof-and-mouth disease and avian coccidiosis.

In 1984, a new Office of Cooperative Interactions was formed in ARS. This office reports directly to the Administrator and serves as a focal point for all technology transfer and related activities.

The patent policy of ARS is structured to encourage and support exclusive licensing, which increases the incentive for agribusiness firms to commercialize ARS technology. The National Technical Information Service handles ARS exclusive licenses and forwards royalties to the Treasury.

We also have an Invention Awards Program to recognize and reward our employees. So, you see, Mr. Chairman, we are indeed responding to some of the concerns addressed by the legislation you have under review.

In closing, Mr. Chairman, and as a further example of our concern and action in this arena, I must mention the Secretary's interest in this important issue as evidenced by the Challenge Forum sponsored by USDA in October 1984. The Forum was an attempt to stimulate public-private partnerships among industry, associations, publishing, academia and government to promote the development of new products, new product uses and new markets. We feel it was an important and successful conference.

We expect to continue these kinds of activities as we strive to provide new opportunities through our research, extension, and teaching efforts to develop new approaches for strengthening the agricultural sector.

Mr. Chairman, that completes my prepared statement, I will be pleased to respond to any questions you may have.

Mr. BROWN. Thank you, Dr. Bentley. It is good that you go first because most other agencies of the Government that have technology transfer or technology utilization programs have to one degree or another been modeled on the example of the agricultural extension, it seems to me. And of course no model can be precisely replicated in a different setting, but we are trying to learn from the experience that you pioneered in the Department of Agriculture, how best to perform this function in other areas where it might be relevant.

Mr. Gillam, perhaps you can go next and describe NASA's situation.

Mr. GILLAM. Thank you, Mr. Chairman and members of the subcommittee. I wish to thank you for the opportunity to participate in these hearings to consider technology transfer issues and to review recently introduced legislation to amend the Stevenson-Wydler Technology Innovation Act. The administration is developing a position on the legislation and we will comment on the merit at a future date.

In the interest of time, Mr. Chairman, I would like to summarize my prepared statement by just touching on the highlights of that statement.

Mr. BROWN. Without objection the full statement will appear in the record.

Mr. GILLAM. Since 1962, Mr. Chairman, NASA has actively and aggressively carried out its congressional mandate contained in the Space Act of 1958 to broadly disseminate and transfer aerospace tehcnology to U.S. industry and to other user constituencies through its Technology Utilization Program. This program, which has evolved experimentally over the years, now consists of and operates as a nationwide system whereby industry can gain effective access to a wide range of technologies made available through that system.

Publications and announcements of potentially useful technologies, computerized access to scientific and engineering reports, computer software availability, selective access to laboratory scientific and technical personnel, and applications projects now comprise the system within which NASA operates its technology transfer activities.

The NASA TU Program is designed to promote and encourage the effective use and commercial application of aerospace-derived technological advancements throughout the United States economy. It operates under the leadership of a small staff at NASA headquarters as an agencywide Office of Research and Technology Applications [ORTA].

The entire NASA Technology Utilization Program works to assure that all new advancements in aeronautical and space technology are reasonably accessible to industry in all areas of the Nation, regardless of whether the technology originates within NASA or its contractors. In order to encourage innovation and the prompt reporting of new technologies by NASA employees and its contractors, the program is also supported by the NASA Inventions and Contributions Board and its broad program of awards and incentives.

The opportunities for technology transfer in both the private and public sectors are many and varied; thus requiring a high degree of system flexibility. Moreover, tech transfer processes must maintain a high degree of technical competence and credibility in order to effect meaningful and tangible end uses of the technology. Additionally, it is important that effective outreach efforts be maintained so that industrial firms, both large and small, as well as other potential users be continually apprised of the opportunities which are available to access and utilize externally generated technologies applicable to their needs.

In our view, this latter requirement—to maintain effective outreach to industry and other users of technology—represents the most difficult and yet one of the most important tasks of all the Government laboratories and agencies. At NASA we believe that our nationwide network of university-based industrial application centers established for this purpose is an effective means to continually promote and to stimulate industrial and corporate interests in the available advanced technologies, emanating not only from NASA centers, from other Government laboratories as well.

Over the past few years, most of the States have undertaken technology or new expanded activities to apply science and technologies to their businesses and industrial activities. Other less formal interfaces between NASA and other Federal labs are also beginning to evolve. Thus an ever-expanding industrial outreach infrastructure exists which we believe could serve as one model for other Government laboratories, thereby providing U.S. industry broader and more direct access to all Government technologies and laboratories on a problem/need basis.

Such efforts would markedly increase and accelerate the transfer of technology and the use of Government-generated technology, thus enhancing the commercial use of these technologies, improving industrial productivity, and creating a stronger industrial competitive base nationwide. It is from the perspective of our experience in this program that we are providing you with the information that we have in our testimony today.

We clearly support the concept of cooperative R&D arrangements of the private sector to enhance and promote the transfer and use of Federal technologies, including the use of unique facilities and/or equipment as a means of encouraging innovation and technological advancement. Such agreements have been used by NASA quite effectively in the past, and continue to serve well in support not only of technology utilization, but commercialization of space ventures as well.

Because of NASA's long experience in technology utilization in the management of its intellectual property rights and the immediate extensive value of many of NASA's innovation or private commercial enterprises, we have built a body of guidelines balancing permission to NASA inventors to commercialize their inventions with safeguards against conflicts of interest and interference with other NASA mission requirements.

In conclusion, Mr. Chairman, let me offer the following suggestions as to how the program might be improved. First, Mr. Chairman, it is our opinion that the system for transfer of Government developed technology is developing in the appropriate direction.

The role the States are playing is significant in our experience, and Federal action should not preempt their involvement.

Second, the system is heavily dependent on the importance attached to technology transfer by agency and laboratory needs. A part of NASA's relative success has been the unique clarity of the Agency's Space Act mandate. Third, there are too many proposals to correct the entire system by turning this or that knob in a certain way. With clear responsibility in mandate, but with flexibility in the use of resources to accomplish that mandate, we believe that the present system should continue to develop in positive directions.

And finally, the guiding concept should be to encourage networking and cooperation among agencies to minimize duplication of efforts and yet provide U.S. industry, the real target of our efforts, with the technologies that best fit its needs as it sees them.

Mr. Chairman, it has been a pleasure to come before you and to discuss this important issue in keeping with the spirit and intent of the Stevenson-Wydler Innovation Act and under the farsighted authorities of NASA's Space Act. We believe that NASA has achieved a high degree of success in fostering and implementing the transfer of technology to industry, academia, and the public nationwide.

NASA's experience and direct support in cooperation with all Federal agencies could materially enhance the achievement of technology transfer and utilization objectives throughout the Government.

[The prepared statement of Mr. Gillam follows:]

Statement of

Mr. Isaac T. Gillam IV
Assistant Administrator
for
Office of Commercial Programs

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

before the
Subcommittee on Science, Research and Technology
Committee on Science and Technology
U.S. House of Representatives

Mr. Chairman and Members of the Subcommittee:

I wish to thank you for this opportunity to participate in these hearings to consider technology transfer issues and to review recently-introduced legislation to amend the Stevenson-Wydler Technology Innovation Act. The Administration is developing a position on the legislation and we will comment on the merit at a future date.

Since 1962, NASA has actively and aggressively carried out its Congressional mandate contained in the Space Act of 1958 to broadly disseminate and transfer aerospace technology to U.S. industry and other user constituencies through its Technology Utilization Program. This program, which has evolved experientially over the years, now consists of and operates as a nationwide system whereby industry can gain effective access to a wide range of technologies made available through that system. Publications and announcements of potentially useful technologies, computerized access to scientific and engineering reports, computer software availability, selective access to laboratory scientific and technical personnel, and applications projects now comprise the system within which NASA operates its technology transfer activities.

Mr. Chairman in your letter of May 9, 1985, to NASA, you specifically requested our views on several subjects. These were: (1) how the results of Federally-funded research and development can more effectively be brought to the American commercial marketplace; (2) what improvements need to be made to P.L. 96-480; and (3) what structural changes need to be made in the Federal government's efforts to accelerate the rate of U.S. technological innovation.

Before answering those questions, I would like to briefly focus attention on NASA's Technology Utilization (TU) Program -- a program of nationwide scope which we believe has been successful, and one which we believe should be continued. It has a solid yet flexible statutory basis in the Space Act which allows us to fine-tune and adjust implementing procedures to meet changing needs.

The NASA TU program is designed to promote and encourage the effective use and commercial application of aerospace derived technological advances throughout the U.S. economy. It operates under the leadership of a small staff at NASA Headquarters as an Agencywide "Office of Research and Technology Applications (ORTA)" and includes:

- a Technology Utilization Office at each NASA laboratory (or field center);
- the preparation of new technology reports (NTR) on each invention, discovery, innovation, or improvement resulting from NASA-supported R&D conducted by NASA laboratories or contractors;
- the evaluation of each NTR for commercial significance by a team of technical experts;
- the preparation and issuance of NASA Tech Briefs, a quarterly journal highlighting those inventions and innovations having the greatest commercial potential;
- the availability of more detailed technical information in support of the announcements in NASA Tech Briefs;
- the support of a nationwide network of Industrial Applications Centers (IAC's) which provide for governmental, commercial and industrial access to NASA's technology;
- support of a Computer Software Management and Information Center (COSMIC) which makes government-developed computer programs available to industry, government and academic institutions;
- an Applications Team which cooperates with public and private sector institutions in applying aerospace technology to meet public sector needs;
- the support of technology applications projects in cooperation with the public and private sectors, to accelerate the availability of aerospace technology for non-aerospace uses having high public priorities; and

promotion of conferences and seminars for U.S. industry on current and proposed NASA research and development, and on its significant results.

In addition, NASA conducts an active patent licensing program under its implementation of the direct licensing authority provided by Sections 207 and 208 of Title 35, United States Code.

This program is carried out in close coordination with the Technology Utilization Program in that historically NASA has always viewed its patent program as an integral part of NASA's overall technology transfer objectives.

The entire NASA Technology Utilization Program works to assure that all new advancements in aeronautical and space technology are reasonably accessible to all industry in all areas of the nation, regardless of whether the technology originates within NASA or its contractors. In order to encourage innovation and the prompt reporting of new technologies by NASA employees and its contractors, the program is also supported by the NASA Inventions and Contributions Board and its broad program of awards and incentives.

The opportunities for technology transfer in both the private and public sectors are many and varied; thus requiring a high degree of system flexibility. Moreover, technology transfer processes must maintain a high degree of technical competence and credibility in order to effect meaningful and tangible end uses of the technology. Additionally, it is important that effective outreach efforts be maintained so that industrial firms, both large and small, as well as other potential users be continually apprised of the opportunities which are available to access and utilize externally-generated technologies applicable to their needs.

In our view, it is this latter requirement -- to maintain effective outreach to industry and other users of technology -- that represents the most difficult and yet one of the most important tasks for all government laboratories and agencies. At NASA, we believe that our nationwide network of university-based Industrial Applications Centers (IAC's) established for this purpose is an effective means to continually promote and stimulate industrial and corporate interest in available advanced technologies -- emanating not only from NASA centers but from other government laboratories as well. The NASA-sponsored IACs have been working for years, cultivating strong ties with business and industry -- identifying and accessing industrial client problems and technological interests and then brokering available information and human resources to fulfill those needs. The NASA Industrial Applications Centers are, moreover, presently

expanding their outreach initiatives by developing linkages and working relationships with State-sponsored institutions and universities across the U.S. to provide even greater industrial coverage than has been possible.

Over the past few years, most of the states have undertaken new or expanded activities to apply science and technology to their business and industrial development objectives. These activities have offered new opportunities for NASA to engage in cooperative Federal-state action to stimulate economic growth through technology transfer. A number of states have expressed interest in participating in a nationwide network based on the expansion of the NASA Industrial Applications Center (IAC) network, and are already investing their own funds in this effort. NASA is coordinating with these states and others to develop the appropriate network interfaces to accommodate increased access to NASA and other Federal technologies.

The NASA IAC's at the Universities of Pittsburgh, Southern California and Florida, in particular, have had considerable success in building these technology transfer interfaces with universities and institutions in their service areas. Key to these relationships is the Remote Interactive Search System (RISS) which provides real-time information search capabilities through remote telecommunications links, thus permitting industry in the participating states easy access to technical information and technology transfer services without the costly requirement of setting up duplicative search and transfer capabilities. Coordination and referral to scientific and engineering experts in NASA laboratories is also a significant element of the NASA IAC transfer service.

In the West, an experimental effort is already underway to extend this service provided by the USC-IAC to other Federal laboratories in the FLC Far West Region. Other less formal interfaces between NASA IAC's and other Federal labs are also beginning to evolve.

Thus, an ever-expanding industrial outreach infrastructure exists which, we believe, could serve as one model for other government laboratories, thereby providing U.S. industry broader and more direct access to all government technologies and laboratories on a problem-need basis. Such efforts would markedly increase and accelerate the transfer and use of government-generated technology, thus enhancing commercialization of these technologies, improving industrial productivity and creating a stronger industrial competitive base nationwide.

NASA conducts and supports these technology utilization and transfer activities under the authorities provided in the National Aeronautics and Space Act of 1958, as amended. The Space Act, for example, already permits the Agency to enter into cooperative research and development agreements with the private sector. This includes sufficient flexibility to negotiate licensing arrangements for use of NASA-owned patents in the conduct of such activities, as well as the allocation of rights to inventions arising out of such cooperative agreements. Moreover, the Space Act provides NASA the authority to reward or incentivize its employees through its Inventions and Contributions Board.

It is from the perspective of our experience with this program that we address your questions. We clearly support the concept of cooperative R&D agreements with the private sector to enhance and promote the transfer and use of Federal technologies, including the use of unique facilities or equipment, as a means of encouraging innovation and technological advancement. Such agreements have been used by NASA quite effectively in the past and continue to serve well in support not only of technology utilization but commercialization of space ventures as well.

At NASA, the authority for entering into cooperative research arrangements is delegated from the Administrator to the Associated Administrator level rather than directly to the directors of NASA's field center laboratories. Similarly, the authority to negotiate patent licensing agreements currently resides in the Office of General Counsel. Thus, under NASA's current approach there is a consistency throughout the organization in the negotiation of cooperative agreements. Such Agency-wide consistencies, we believe, make it easier for the private sector participants to interact cooperatively with NASA. NASA has an Inventions and Contributions Board (ICB) which, by awarding all inventors, provides a flexible and equitable system to stimulate technology transfer. The ICB considers a wide range of evaluation factors, including licensing history and royalty records as well as overall significance of the invention or contribution to the Agency's mission goals whether or not such inventions or contributions are commercially significant. Thus, by allowing the ICB to consider both main mission goals and commercial potential, we believe we have an established system which is fair to all inventors and to all others who are involved in the transfer process.

Because of NASA's long experience in technology utilization and the management of its intellectual property rights, and the immediate and extensive value of many NASA innovations for private commercial enterprises, we have built up a body of

guidelines balancing permission to NASA inventors to commercialize their inventions with safeguards against conflict of interest and interference with other NASA mission requirements.

In conclusion, let me again return to your questions and in that context suggest four improvements which would help answer all of these.

First, Mr. Chairman, it is our opinion that the system for the transfer of government-developed technology is developing in the right direction. The role the states are playing is significant in our experience, and Federal action should not preempt their involvement.

Second, the system is heavily dependent on the importance attached to technology transfer by agency and laboratory needs. A part of NASA's relative success has been the unique clarity of the Space Act mandate.

Third, there are too many proposals to correct the entire system by turning this or that knob in a certain way. With clear responsibility and mandate, but with flexibility in the use of resources to accomplish this mandate, we believe that the present system can continue to develop in positive directions.

And finally, the guiding concept should be to encourage networking and cooperation among agencies to minimize duplication of efforts, and yet provide U.S. industry -- the real target of our efforts -- with the technologies that best fit its needs as it sees them.

Mr. Chairman, it has been a pleasure to come before you to discuss this important issue. In keeping with the spirit and intent of the Stevenson-Wydler Innovation Act, and under the farsighted authorities of the Space Act, we believe that NASA has achieved a high degree of success in fostering and implementing the transfer of its technology to industry, academia and the public nationwide. NASA experience and direct support in cooperation with all Federal agencies could materially enhance the achievement of technology transfer and utilization objectives throughout the Federal government.

Mr. BROWN. Thank you very much, Mr. Gillam.

Next Colonel Carter.

Colonel CARTER. Mr. Chairman, and members of the subcommittee, thank you for inviting me here today. I am pleased for the opportunity to describe briefly the technology transfer program of the Department of Defense for ensuring that the results of the Department of Defense research investments are used to the best advantage in the private sector as well as meeting the military needs.

This has always been and continues to be a major objective of the Department. We recognize the continuing responsibility of the Federal Government in general, and the Department of Defense in particular, to ensure the maximum transfer of the results of our research investment to the public and private sectors of this country.

I have submitted a formal statement for the record, and I would like to summarize it, if I might.

Mr. BROWN. Please do.

Colonel CARTER. DOD funds a full spectrum of technologies, from engineering to biology, from basic research to product development. Most of the RDT&E we fund, about 75 percent of it, is contracted out to industry and universities which are engaged in defense as well as nondefense work.

DOD must of necessity overcome Soviet superiority in numbers with superior technology, building on our excellent universities and industrial know-how, using defense resources to maximize the payoff for defense by transferring scientific and technical information as widely as possible to performers of R&D in U.S. industry, nonprofits, universities, and government laboratories.

This transfer is accomplished in many ways. It is done most effectively by direct interaction among scientists and engineers. Another essential ingredient is motivation, which can be encouraged by a system of fair and equitable rewards but especially by providing the stimulating work environments in which science and technology thrive.

That includes modern instrumentation, an adequate technical support system, freedom to explore new ideas and opportunities within the laboratory missions, and a minimum of bureaucratic delays and paperwork. Efficient technology transfer also requires good communications among planners, managers, and performers between sponsors and contractors, as well as among scientists and engineers. It also requires a good documentation or library system; I would like to say more about that later, but first, I would like to say a few words about some of the outstanding accomplishments that we have been able to perform in transferring our technology.

The first of these is in technology aiding paraplegics: One of the most unusual spinoffs of antisubmarine warfare technology has made it possible for patients with complete transection of the spinal cord to sit, stand, and walk under their own control. This seemingly impossible feat has been accomplished by capturing and interpreting myoelectric signals from above the level of the spinal cord injury and transmitting them to the paralyzed muscles below—in effect detouring around the lesion. This was done primarily by using the technology we have developed in signal processing.

Integrated circuits has been a well-known DOD accomplishment for some time. The first integrated circuits were developed in the 1960's fabricated under DOD funding. Much of the development and use of IC's in the 1960's and early 1970's were supported by DOD. That work provided the very strong base for commercial applications, applications such as hand-held calculators, watches, microcomputers, video games are all evolutions from that technology base.

Magnetrons are a key element in radar, developed in the 1940's. Further development made them available to industry at a cost of about $2,000 in the late 1950's; but today's automated assembly and improved reliability techniques have made magnetrons practical for household applications, such as in microwave ovens. A typical cost of a magnetron today is about $20 to $30.

Other areas of significant accomplishments include acute trauma care, CAT scan medical diagnostic technique, firefighting foam, and many accomplishments in aeronautics and materials.

The DOD laboratories continue to engage in technology transfer through many avenues. For example, the laboratories are active participants in the Federal Laboratory Consortium. They are major contributors to users of the Defense Technical Information Center and the National Technical Information Services. The DOD laboratories provide these institutions up-to-date status reports on both in-house and contracted laboratory R&D. The labs provide data to some 22 Defense Information Analysis Centers which make available specific, focused advice to customer inquiries. Besides the publication of technical reports on their DOD work, the laboratories also pursue local initiatives. These include laboratory open house meetings with industry; advanced planning briefings for industry; annual publication of laboratory progress reports listing past accomplishments, work in progress, and future year plans; and support of information for industry offices.

In compliance with Public Law 96-480, each DOD laboratory has established an Office of Research and Technology Application [ORTA], which operates in conjunction with the Scientific and Technical Information Office, the Data Management Office, the Public Affairs Office, the Technical Intelligence Program, and the Foreign Disclosure Program. The Technology Application Assessment called for in Public Law 96-480 is reported regularly to the laboratory management. Each laboratory director, with assistance of the ORTA, identifies projects applicable to the nondefense community, that is, to State and local governments and to private industry.

In summary, we have evolved an excellent program to promote domestic technology transfer to nondefense applications. We believe firmly in the importance of science and technology to the national security, and to our economic vitality. We recognize that military and civilian technology are interdependent and mutually supportive. We have tried to provide the framework where scientists and engineers can develop their ideas within the mission of their laboratories or agencies with a minimum of bureaucratic and time-consuming diversions which detract from their productivity.

We appreciate very much the congressional support for our efforts, for our laboratories, and for our science and technology R&D

program. They have paid off handsomely for DOD and for the Nation.

Although our mission is defense, there is a long, unbroken history of working effectively with State and local government, and the private sector. We believe ours is a tradition fully consistent with the intent of Public Law 96-480. The rebuilding of our military industrial base demands technological innovation, which can be found wherever there is good scientific and technical communication. We must therefore continue to reduce barriers to the transfer of information in ways that are consistent with our national security responsibilities. The Department of Defense has an excellent record in technology transfer, borne of genuine need. We are committed to continue efforts in this area, and will continually update policy guidance and direction to achieve the desired results.

Thank you, Mr. Chairman.

[The prepared statement of Colonel Carter follows:]

THE DEPARTMENT OF DEFENSE

STATEMENT ON

DOMESTIC TECHNOLOGY TRANSFER

by

COLONEL DONALD I. CARTER, USAF

ACTING DEPUTY UNDER SECRETARY OF DEFENSE

for

RESEARCH AND ADVANCED TECHNOLOGY

Mr. Chairman and Members of the Committee:

Thank you for inviting me here today. I am pleased to have the opportunity to describe briefly the technology transfer program of the Department of Defense for ensuring that the results of DoD research investments are used to best advantage in the private sector as well as in resolution of military needs. This has always been and continues to be a major objective of the Department. We recognize the continuing responsibility of the Federal Government in general, and the Department of Defense in particular, to ensure the maximum transfer of the results of our research investment to the public and private sectors of this country.

DoD funds a full spectrum of technologies, from engineering to biology, from basic research to product development. Most of the R&D, about 75 percent of it, is contracted out to industrial laboratories which are engaged in defense as well as non-defense work. The basic research is also largely contracted out, about 50 percent of it being performed at universities and about 20 percent in industrial research laboratories; DoD sponsored research on university campuses is performed in the same laboratories as similar research sponsored by NSF, DoE, NASA, NIH, and other Federal agencies, as well as research sponsored by industry. University faculty members consult for industry, take sabbaticals at DoD laboratories (facilitated by the Intergovermental Personnel Act), and interact strongly with their academic peers as well as with industrial, DoD and other governmental laboratories. Finally, research workers from all sectors meet, exchange ideas, and stimulate one another at professional society conferences, many of which are hosted at or with the cooperation of DoD laboratories (especially if classified sessions are involved.)

- ASW Technology Aiding Paraplegics: One of the most unusual spin offs of anti-submarine warfare technology has made it possible for patients with complete transection of the spinal cord to sit, stand, and walk under their own control. This seemingly impossible feat has been accomplished by capturing and interpreting myoelectric signals from above the level of the spinal cord injury and transmitting them to the paralyzed muscles below - in effect detouring around the lesion.

- Firefighting Foam: Originally developed for Naval Air Stations, Aqueous Film Forming Foam (AFFF) or "Light Water" is now the standard firefighting agent for all aircraft carriers and most other ships. It is also used at most commercial airfields, refineries and other areas, military and civil, where potentially catastrophic fuel fires occur.

- Airframe Composites: Extensive use is being made of DoD-developed composites technology in commercial transport aircraft. The new Boeing 757 and 767 aircraft are using composites in the wing, fuselage, and empennage structures.

- Integrated Circuits: The first IC's (1960) were fabricated under DoD funding. Much of the development and use of ICs thru the 60's were supported by DoD. That work provided a strong base for commercial applications during the 70's. Hand-held calculators, watches, microcomputers, video games are all evolutions from that base.

- Microwave Ovens: Magnetrons are a key component of radar, developed in the 40's. Further development made them

DoD must of necessity overcome Soviet superiority in numbers with superior technology, building on our excellent universities and industrial know-how, using DoD resources to maximize the payoff for defense by transferring scientific and technical information in the possession or under the control of DoD as widely as possible to performers of R&D in U.S. industry, non-profits, universities, and government laboratories. This transfer is accomplished in many ways. It is done most effectively by direct interaction among scientists and engineers. Another essential ingredient is motivation, which can be encouraged by a system of fair and equitable rewards but especially by providing the stimulating work environment in which science and technology thrives. That is modern instrumentation, an adequate support system, freedom to explore new ideas and opportunities within the laboratory mission, and a minimum of bureaucracy and bureaucratic delays and paper work. Efficient technology transfer also requires good communications among planners, managers and performers, between sponsors and contractors, as well as among scientists and engineers. It also requires a good documentation or library system; I want to say more about that later, but first, if I may, I'd like to remind you briefly about DoD's considerable record of accomplishments and then say a few words about the role of our laboratories and about our University Research Initiative which will encourage research, innovation and technology transfer.

A short list of accomplishments arising out of DoD research follows.

- o CATSCAN: Navy research in ocean acoustic tomography led to CATSCAN. Tomography is a technique for description of a region by multiple sampling of wave fields which have traversed the region. CATSCAN techniques have become an invaluable diagnostic technique, for example, for locating brain tumors.

available to industry at a cost of about $2,000 in the late 50's. Today's automated assembly and improved reliability techniques have made magnetrons practical for household applications, such as microwave ovens. Typical cost of a magnetron is $20 - $30.

- NITINOL - "Material with a Memory": NITINOL was invented about 20 years ago at the Naval Ordinance Laboratory. It has the property that when it is warmed up it resumes its earlier pre-shaped geometry. Apart from its many applications in the military (fuzes, temperature control and other such mechanisms) it is now being used in such diverse areas as orthodontia (arch wires) resulting in fewer visits to the dentist and less pain, and in electricians insulating shields for splices.

- Acute Trauma Care: There are many examples of developments by the military which are in use in civilian medical practice. Some of these are the preservation of blood and blood components, anti-shock trousers, cyandacrylate wound glue, sulfamylon cream for burns, surgical techniques for maxillofacial injuries and bone and tissue preservation and replacement techniques.

- Vaccines and drugs for the prevention and treatment of infectious disease: Measles vaccine, meningococcal meningitis vaccine, adenovirus (respiratory disease) vaccine, the anti-malarial drugs chloroquine and mefloquine, and the jet injector gun for mass vaccinations are examples of military developments extensive used in the civilian sector.

- Ring Laser Gyro: The Navy and Air Force have had extensive programs in Ring Laser Gyro development since

1963. These devices are now in production for inertial navigation systems for the Boeing 757, 767 and Airbus A-310 aircraft.

- o Aircraft Engine Improvements: By integrating several technologies including lightweight dynamics/structures, high temperature coatings, fan aerodynamics and airfoil materials and cooling, there has been a steady increase in the thrust to weight ratio of aircraft engines from 6:1 to 8:1 and a concomitant reduction in fuel consumption of 15 percent.

In addition to the transfer of technology to the private sector, DoD laboratories have become increasingly involved with State and local government to ensure the transfer and exchange of technologies and expertise. For example, the Chief Scientist at the Air Force Weapons Laboratory (AFWL) is a member of the New Mexico Governor's Technical Excellence Committee which created the State Research Program, the Science Engineering Equipment Funds, and the Rio Grande Research Corridor and its Center of Excellence at three New Mexico universities. The purpose of the Rio Grande Research Corridor is to eventually stimulate the location of high-technology industries to this area, and to provide greater research services primarily to existing Federal research installations as well as private industry.

The Air Force and the State of Ohio have entered into an agreement regarding technology transfer. The Memorandum of Understanding and accompanying charter established a council to act as an oversight committee for the transfer of Air Force Wright Aeronautical Laboratories non-restricted technologies to State and local governments, universities, and the private sector in the State of Ohio. These technologies are transferred through consultations and assistance provided by the laboratory engineers and scientists in their areas of expertise.

The DoD laboratories continue to engage in technology transfer through many avenues. For example, the laboratories are active participants in the Federal Laboratory Consortium, they are major contributors to users of the Defense Technical Information Center (DTIC), and the National Technical Information Services (NTIS). The DoD laboratories provide these institutions up-to-date status reports on both in-house and contracted laboratory R&D. The labs provide data to the Information Analysis Centers which make available specific, focussed advice to customer inquiries. Besides the publication of technical reports on their DoD work, the Laboratories also pursue local initiatives. These include laboratory "open-house" meetings with industry; advanced planning briefings for industry; annual publication of laboratory progress reports listing past accomplishments, work in progress, and future year plans; support of Information for Industry Offices (IFIO's); and the Potential Contractor Program (PCP) which was established to certify and register non-government activities for access to controlled scientific and technical information.

In compliance with PL 96-480, each DoD laboratory has established an Office of Research and Technology Application (ORTA), which operates in conjuction with the Scientific and Technical Information Office, the Data Management Office, the Public Affairs Office, the Technical Intelligence Program, and the Foreign Disclosure Program. The Technology Application Assessment called for in PL 96-480 is reported regularly to the laboratory management. Each laboratory commander/director, with assistance of the ORTA, identifies projects applicable to the non-defense community, that is, to State and local governments and to private industry. These assessments are made available, but only after ensuring that the provisions of the law are met as far as the dissemination of information and cooperation with local government is concerned. A DoD regulation on the Domestic Technology Transfer Program is currently being printed to provide policy and

guidance to all DoD components that perform R&D efforts. This regulation will facilitate the development of new technologies for transfer to State and local governments and to the private sector.

We have not neglected the universities, which perform most of the nation's basic research. We have proposed a University Research Initiative to start in FY 86 which would strengthen the university infrastructure in several ways, including the establishment of multidisciplinary science and engineering research centers, which would provide for the exchange of scientists and engineers between universities and DoD laboratories to increase the flow of ideas and technologies to where they will do the most good.

In the management of R&D, new initiatives are always called for to respond to changing conditions:

- The Small Business Innovation Research (SBIR) program, signed into law in 1983, was preceded in DoD before it was mandated by Congress with a similar program, and is working well. DoD has strongly encouraged small research businesses to look to universities for innovative ideas and consulting help, and vice versa, has encouraged university researchers to go to small businesses to develop their ideas into products.

- An initiative started two years ago under the IR&D program to encourage stronger interactions between large defense contractors and universities is now beginning to bear fruit. First reports are very encouraging.

- The ultimate goal of our Science and Technology Information Program (STIP) is to strengthen domestic technology transfer through documentation. The recently

formed STIP Steering Committee is chaired by the Director for Research and Laboratory Management, with three committees reporting to it.

- One of these committees is concerned with the operations of the Defense Technical Information Center (DTIC), which is a repository of DoD research reports, both classified and unclassified, as well as of planning documents valuable not only within DoD, but also to industry planners and managers of IR&D, and other industry programs. DTIC also performs numerous special and invaluable services, for example to small businesses wishing to participate in DoD's Small Business Innovation Research Program. DTIC provides on-line information to many contractors by electronically communicating from the DTIC computer to company computers.

- A second committee under the STIP Steering Committee is concerned with planning information for industry, and attempts to release as much program and budgetary information to industry as feasible.

- The third committee is the Domestic Technology Transfer Committee, and it is concerned with the transfer of DoD research results to industry, universities, State and local government, as effectively as possible. To that end it works with other government agencies, includes on it a representative from the Federal Laboratory Consortium (FLC), and assists with carrying out the intent of Congress according to the Stevenson-Wydler Act.

I hope I have conveyed to you the enthusiasm and diversity of DoD activities to promote domestic technology transfer. We believe firmly in the importance of science and technology to the

national security, and we recognize that military and civilian technology are interdependent and mutually supportive. We have tried to provide the framework where scientists and engineers can develop their ideas within the mission of their laboratories or agencies with a minimum of bureaucratic and time consuming diversions which detract from their productivity.

We appreciate very much Congressional support for our efforts, for our laboratories, for our science and technology R&D programs, for our Science and Technology Information program, and for the Defense Technical Information Center (DTIC). They have paid off handsomely for DoD and the nation, but we shall continue to strive to do even better.

Although DoD's mission is Defense, there is a long unbroken history of working effectively with State and local government, and the private sector. We believe ours is a tradition fully consistent with the intent of PL 96-480. The rebuilding of our military industrial base demands technological innovation, which can be found wherever there is good scientific and technical communication. We must therefore continue to reduce barriers to the transfer of information in ways that are consistent with our national security responsibilities. The Department of Defense has an excellent record in technology transfer, borne of genuine need. We are committed to continue efforts in this area, and will continually update policy guidance and direction to achieve the desired results.

Mr. BROWN. Thank you very much, Colonel Carter.

Mr. Joseph?

Ms. JOSEPH. Mr. Chairman and members of the subcommittee, I am pleased to appear before you to discuss the technology transfer policy and activities of the Department of Energy.

As the last witness in a very long morning, I promise to make my summary very brief. The U.S. science and technology base includes a superb university system, the most advanced government laboratories, and the largest R&D budgets in the world.

But it is clear that we need to give more attention to harnessing our scientific and technical strengths for the overall benefit of our Nation's economy.

The laboratories and technology centers of the Department of Energy are a major part of the U.S. technology base. We have taken important steps to encourage the transfer of research and development from these institutions to the private sector.

As you have heard this morning, the researchers in our laboratories also have a natural motivation to see their discoveries utilized for the national good. As you heard from each of the witnesses, the key to our technology transfer policy and program is person-to-person interactions, between our laboratory researchers and industrial counterparts.

Success also lies in American industry's own motivation to obtain Government-developed technology from the laboratories. It is our hope that hearings like this will help in that motivation.

With all of this in mind, in 1982, we developed and issued a class waiver policy granting patent rights to users in advance for all inventions when industry has reimbursable work done in their laboratories or when industry or universities carry out work at our designated user facilities. There are over 20 laboratories with over four dozen designated user facilities that are available to the private sector in DOE.

With this incentive, industry and university interaction with the laboratories increase. The Department has issued guidelines encouraging laboratory professional staff to consult with the private sector. This has stimulated the increased person-to-person interactions between laboratory and university and industry scientists.

Most recently, Senator Domenici added funds in fiscal year 1985 for a laboratory-industry-technology transfer fellowship, which we are also about to launch, which will provide high-level industry researchers with a technology transfer interest and mission an opportunity to work at the major national laboratories for up to a year, on a cost-shared basis.

On the national scene, we have responded to the Stevenson-Wydler Technology Innovation Act of 1980, and have required each major laboratory to establish a focal point, an Office of Research and Technology Applications, and to upgrade its interactions with industry.

Our departmental patent policy is responsive to the recent congressional legislation as well, and in effect, patent rights covering nondefense, federally supported work at most national laboratories will be available to the Government-owned contractor-operated contractors who operate these facilities in accordance with the provisions of the law.

Consistent with the intent of Public Law 96-480, the Department publishes the research and development laboratory technology transfer program annual report. Instead of bragging about our accomplishments, I am making this available for the record, and will not try to summarize it.

Mr. BROWN. I would appreciate it if you would do that. I would like to look at that.

[The report submitted is Technology Transfer '83, U.S. Department of Energy Research and Development Laboratory Technology Transfer Program. First year Annual Report, December 1984, DOE/ER-0192. It is available from the National Technical Information Service, U.S. Department of Commerce, Springfield, VA 22161.]

Ms. JOSEPH. This publication does summarize the highlights of the technology transfer activities at the major Department laboratories. It also lists the technology application assessments that are done, the technical information Energygrams by laboratory, and it provides a listing of the laboratory program contact personnel and all of the ORTA's, with their addresses and phone numbers.

You heard from a few of them this morning, from Mr. Stromberg and Mr. Stark, so I don't need to go further to discuss the quality of the ORTA's in our major national laboratories.

Also, as Paul Gray emphasized in his testimony, we strongly believe that U.S. leadership and accomplishments in science, technology, and economic growth are beneficiaries of properly conceived programs of basic research.

While contributions from basic research cannot always be identified immediately or directly, the knowledge that flows from this research forms the foundation on which new ideas and concepts can be built in each of these areas.

During the past year, our DOE basic energy science research was conducted at universities and laboratories in areas that include material science, chemical science, nuclear science, and advanced energy projects.

Examples of some of the research results that are very impressive are included in my testimony, and I will resist the temptation to elaborate on them here.

While it is not possible to say which of these research accomplishments might be of major strategic or economic importance to the future, it is important to realize that today's high-technology industry is based on similar research carried out in the past.

In addition, and as a bureaucrat, I should stress that our Government laboratories are also encouraged to support the broader effort which the Stevenson-Wydler Act promotes, in order to improve technology transfer to the U.S. industry by facilitating the identification of appropriate laboratory technology; implementing positive action to identify and inform interested firms or investors; and supporting through joint efforts with industry developmental efforts to commercialize spinoff technology.

Since the implementation of Stevenson-Wydler, and with the liberalization of patent policy, the Department's laboratories have been more actively seeking cooperative initiatives with universities and industry to develop and commercialize U.S. Government laboratory technology, and you have already heard some examples of those.

In summary, industrial innovation is central to the economic well-being of the United States. The Department of Energy laboratories and technology centers are world-class research and development organizations.

As I testified before this committee in 1982, over the years, the technology generated in mission areas of the Department of Energy has been reapplied in industry for use in commercial products and processes in a significant number of areas. These range from nuclear power, nuclear medicine, radiation processing, ion implementation, materials advances, to fluidized bed coal combustion, and super-computers.

These extensive technology transfers have come about as a result of research and development sponsored by the Department. Today, the Department's Research and Development Technology Transfer Program also serves to better organize and accelerate this technology spinoff process.

We will, consistent with our commitment to technology transfer, which is communicated to the laboratories at the highest level, with policy guidance with the Secretary of Energy, continue to facilitate and improve an interactive atmosphere among Department of Energy laboratories, technology centers and industry, State and local governments and universities.

Thank you, Mr. Chairman.

[The prepared statement of Ms. Joseph follows:]

Statement of Antionette Grayson Joseph

Director of Field Operations Management

Office of Energy Research

Department of Energy

Mr. Chairman and members of the Subcommittee, I am pleased to appear before you today to discuss technology transfer issues and to present my view of how the results of federally-funded research and development (R&D) can more effectively be brought to the American commercial marketplace for everyone's benefit.

The Administration has H.R. 1572 and H.R. 695 under review and will be prepared to comment at a future date. I would like to express my support of improving the transfer of technology from Government laboratories to the public. While U.S. research and development remains the best in the world, this fact is not adequately reflected in domestic commercialization. Technology is our primary source of competitive advantage in the international marketplace, and we must do more to exploit it.

U.S. Advantages

The U.S. science and technology base includes a superb university system, the most advanced government laboratories, and the largest R&D budgets in the world. We need to give more attention to harnessing our scientific and technical strengths for the overall benefit of our Nation's economy.

In addition, the entrepreneurial nature of the U.S. population and an economic climate that facilitates new ventures are conducive to the generation of new high technology companies and a very powerful feature of the American ability to generate new jobs. Other countries

have come to recognize these fundamental advantages in the U.S. system and are beginning to try to emulate them.

Department of Energy Efforts

The laboratories and technology centers of the Department of Energy (DOE) are a major part of the U.S. technology base. We have taken important steps to encourage the transfer of research and development from these institutions to the private sector. The researchers in our laboratories have a natural motivation to see their discoveries utilized for the national good. The key to our technology transfer policy and program is person-to-person interactions between our laboratory researchers and industry counterparts. Success also lies in American industry's own motivation to obtain Government-developed technology from the laboratories.

With this in mind, in 1982, we developed and issued a class waiver policy granting patent rights to users in advance for all inventions when industry has reimbursable work done at our laboratories or when industry or universities carry out work at our designated user facilities. With this incentive, industry and university interaction with the laboratories increased. The Department has issued guidelines encouraging laboratory professional staff to consult for the private sector. This has stimulated increased person-to-person interactions between laboratory and university and industry scientists.

On the national scene, we have responded to the Stevenson-Wydler Technology Innovation Act of 1980, P.L. 96-480, and have required each

major laboratory to establish a focal point, an Office of Research and Technology Applications, and to upgrade its interactions with industry. Our Departmental patent policy is responsive to Title V of the Federal District Court Organization Act of 1984, P.L. 98-620, and, in effect, patent rights covering nondefense federally-supported work at most national laboratories will be available to the contractors who operate them in accordance with the provisions of that law. As a result, there is already an increased interest in technology transfer opportunities at DOE laboratories.

Consistent with the intent of P.L. 96-480, the Department publishes the Research and Development Laboratory Technology Transfer Program Annual Report. This publication summarizes the highlights of technology transfer activity at the major Department laboratories, lists technology application assessments and technical information Energygrams by laboratory, and provides a listing of laboratory program contact personnel.

It is my strong conviction that technology transfer--essentially imparting know-how from one person to another--is very much a one-on-one, person-to-person interaction. Technology transfer is not accomplished merely by publication of information; nor by conveying patent rights. Although both of these are important elements, we should not be overly optimistic about their impact on the process. From my point of view, a technology transfer program should be structured to encourage and facilitate one-on-one interactions, and I believe the process should enhance such interaction.

United States leadership and accomplishments in science, technology and economic growth are beneficiaries of properly conceived programs of basic research. While contributions from basic research cannot always be identified immediately or directly, the knowledge that flows from this research forms the foundation on which new ideas and concepts can build in each of these areas.

During the past year, DOE Basic Energy Sciences (BES) research was conducted in the following areas: materials sciences; chemical sciences; nuclear sciences; and advanced energy projects. The impact of research results from over 1200 projects cannot easily be conveyed, not only because of their volume, but also because of their ultimate importance may not be evident at first. Examples of research results include:

- Development of a novel processing method that permits machining of materials to a dimension 1000 times smaller than can be accomplished commercially today. One potential application of this method is the development of computer memories with storage densities one million times greater than is presently possible. New applications, such as the one just cited, will require new manufacturing concepts rather than refinement of current ones.

- Discovery of a new catalytic system for the direct conversion of carbon monoxide and water to methanol. This new catalyst makes it possible to make the conversion using water rather than the more expensive hydrogen and at pressures and temperatures much lower than current practice allows.

- Development of improved solid state electronic devices to operate at higher temperatures, thus paving the way to important advances in measurement methods and process control in hostile environments.

- Demonstration of a new source of electromagnetic radiation, known as the free electron laser, at conversion efficiencies and power levels which make the laser a candidate source for numerous applications, including extremely powerful accelerators.

- Development of a new high-temperature, oxidation-resistant material (nickel aluminide) that can be produced by conventional methods and is better than existing super alloys for use where long-term, high-temperature service is required, such as in heat engines. The potential of this aluminide has already been recognized by an IR-100 award as well as industrial interest in producing this material.

While it is not possible to say which of the above research accomplishments might have major strategic or economic importance in the future, it is important to realize that today's high technology industry is based on similar research carried out in the past.

In addition, our Government laboratories are encouraged to support the broader effort to improve technology transfer to U.S. industry by:

- o facilitating the identification of appropriate laboratory technology;
- o implementing positive action to identify and inform interested firms or investors; and
- o supporting, through joint efforts with industry, developmental efforts to commercialize spin-off technology.

Since the implementation of the Stevenson-Wydler Technology Innovation Act of 1980 and with the liberalization of patent policy, the Department's laboratories have been more actively seeking cooperative initiatives with universities and industry to develop and commercialize U.S. Government laboratory technology.

The Department of Energy relies primarily on a system of highly qualified contractors such as major universities or large corporations to operate unique, world class research facilities which are owned by the Federal Government. These are called Government-owned, contractor-operator (GOCO) laboratories.

Compared to about 50,000 GOCO contractor employees who are engaged in research and development, only 700 are Federal employees at Federal laboratories, i.e. Government-owned, Government-operated (GOGO). These include: Morgantown Energy Technology Center, Pittsburgh Energy Technology Center, Bartlesville Project Office, New Brunswick Laboratory, and the Environmental Measurements Laboratory.

The Department of Energy recognizes the value of cooperative research and development agreements, encourages its GOCO laboratories to enter into such agreements, and has issued guidelines to facilitate the process. While ensuring Headquarters control and oversight, this policy effectively decentralizes appropriate implementation responsibility involving cooperative agreements to the Field.

The GOGO laboratories given their small size, rely on Headquarters administrative staff to take on such tasks relating to cooperative agreements. Since they are essentially an extension of the Headquarters operation in the Field, Headquarters may, as desired, delegate the appropriate level of responsibility to the Field.

Summary

Industrial innovation is central to the economic well-being of the United States. The Department of Energy laboratories and technology centers are world-class research and development organizations. Over the years, the technology generated in mission areas of the Department of Energy has been reapplied by industry for use in commercial products and processes. Nuclear power, nuclear medicine, radiation processing, ion implantation, materials advances, fluidized bed coal combustion, and supercomputers are but a few of the extensive technology transfers that have come about as a result of research and development sponsored by the Department. The Department's research and development technology transfer program serves to better organize and accelerate this spin-off process. We will continue to facilitate and improve an interactive atmosphere among Department of Energy laboratories, technology centers and industry, State and local governments, and universities.

Mr. BROWN. Thank you very much, Ms. Joseph.

Frankly, I find all of your testimony, all of the witness' testimony to be exciting and important. I almost come to the conclusion that something is being done right despite whatever we in the Congress can do to foul it up, and I appreciate the signs of progress that you have reported.

It seems obvious that over the past period of time, possibly 5 or 10 years, there has been a growing awareness, which has permeated the entire structure of government, that we do have to review our operations from the standpoint of how they can more effectively benefit the entire society, and that is reflected in all of the testimony that you have given us here.

The legislation that we have before us is an effort to not really revolutionize any of this, but to do a little tinkering that may improve to some degree the activities that are going on, and possibly as much as anything else, indicate a continued congressional interest and support for what you are doing.

And I hope that you will keep that in mind. I am concerned about one problem which is at a level a little bit higher than what is actually being done in the laboratories, and perhaps it can be best illustrated by a question to Dr. Bentley.

Dr. Bentley, you and the Department of Agriculture have initiated within the last 2 or 3 years an effort to make a major move toward the support of research in biotechnology as applied to the plant sciences.

Mr. BENTLEY. Yes, sir.

Mr. BROWN. That has been fraught with some difficulty, but you have persisted in doing that. That illustrates a problem that rises above the level of your land grant college research capabilities and so on.

These are excellent institutions which have been performing great service for 100 years, and yet, we have seen breakthroughs in fundamental biological science which resulted from support for biological research not in the plant sciences, but in another area.

And you have seized upon these breakthroughs as an opportunity for application in the plant sciences with potentially revolutionary impact upon the whole field of agriculture and in other related fields.

That illustrates a kind of a problem which we have in many other areas. We have, for example, in NASA, just to seize an example, the possibility that our Earth-observing capabilities represented by LANDSAT could create a revolutionary industry fundamental to both future science and to future commercial operations.

We have similar illustrations in some of the examples that both Ms. Joseph and Colonel Carter have given. And yet, we do not seem to have at a sufficiently high level of cognizance a capability to determine where the country's interest will be served by a major effort to develop an entire new industry, for example, or a major new initiative of some sort, as represented by the application of biotechnology to the plant sciences.

We don't know where that will lead. Some of the fantastic projections about what is likely to happen may be completely wrong, and the results may pay off in entirely different directions that we haven't thought of yet.

But we know it is worthwhile to pursue that at the basic research level, and at the exploitation of that basic research as soon as it is clear.

Why is it, and this is almost a rhetorical question because I haven't found anybody with a good answer to, why aren't we doing a better job of focusing national energies at a high level on where these primary opportunities to benefit the Nation and all mankind exist, instead of waiting for some other country to perceive the opportunity and get the jump on it, even though we have done the basic research that may be at the root of it?

Could I ask you to philosophize with me about that problem for a moment, and see if you have any suggestions? We won't write it into this legislation.

Mr. BENTLEY. Mr. Chairman, when you ask me to philosophize, why I would be glad to try that, and then perhaps my colleagues would have a more definitive answer. It seems to me I want to go back even to the talking about one of the challenges that we have in education and in industry and in government, and that is the whole matter of how we handle the need for interaction and interdisciplinary activities and communications.

I think that this, as far as the university where I spent most of my career, I think that great universities, one of the challenges they have in terms of maintaining their lead position, if they have it now, is how well they handle this whole business of interaction, multidisciplinary activities and so forth, within universities.

And then, one can take that a step further to industry, how do they interact with industry. We have come out of a tradition of many years, and particularly since World War II, and when I was involved in the post-World War II era, where there was a great deal of attention given, and recognition given to the efforts of individuals, scientists. Nobel Prizes won by individuals, usually, are at least international recognition of the Nobel Prize winner, and of course, I have the greatest admiration for anyone that is even in the running for a Nobel Prize.

But that, as an individual activity, that has a way of suggesting to the scientific community, and particularly to the young investigator that the way to get to the Nobel Prize route is an individual activity, when in fact, the problems that we have to deal with are multifaceted problems involving all that you have referred to so well in your comments.

And I think that this is what we have to do—and I must preface this statement by the fact that I am often overoptimistic of what we are going to get done in this world—that I see a major change taking place. and that the young investigators at the universities where I visited, in our laboratories, in the Agricultural Research Service, and I am sure that is true in all other laboratories as well, is that they are talking more about the joint effort and realizing that if we are going to make these major moves, we have to work together and find new ways to do it.

And part of the responsibility, as I see it, of leadership, whether it is in academia or in Government or—and for that matter, I presume in industry—is to set the environment and create structures that will facilitate and encourage those kinds of cooperations.

In a university, one of the roadblocks and one of the things that you have to overcome is whether or not by, say, interacting strongly with an industry, you are in some way abrogating your responsibility of being at arm's length with the user. Under what kind of conditions can you do this and still retain the so-called "academic purity"?

And I think that is unfortunate we have so much of that, and I notice the nods across the table, you have this with Colonel Carter, for example; this would come up in a defense area very quickly. We have many interactions, as you know, with Agriculture and the Defense Department, and we have had to work very hard together.

So, I think we are challenged to find ways to initiate rules that encourage that, and then we have to have the reward system within academic institutions that recognizes this important role and not be overinfluenced by the thing I referred to earlier, namely the Nobel Prize syndrome in terms of recognition.

You immediately understand that I haven't answered your question. I merely philosophized about it. On the other hand, if we don't conceptualize some way of doing that and approaching it, we will have a continuation of what I think we have had too much in the past.

Mr. BROWN. Well, I really didn't expect you to answer my question.

Mr. BENTLEY. Thank you.

Mr. BROWN. Would any of the rest of you care to comment on that problem? Let me say just before you do that I have been reviewing carefully this latest report from the National Research Council on the competitive status of U.S. industry, an overview which is based upon some studies of individual industries made earlier.

And it is a good, objective, and scientific review of the situation, and it doesn't come to any hard and fast conclusions, but it does point to some things, and just to quote one, it says, "Clearly, this implies," and it is referring to the previous statements, "a need for continuing, coordinated review and awareness of technology and trade issues," and by trade, we mean the competitiveness, the productivity of our services and products with the rest of the world, "continuing review and awareness of these at a high enough level in the Government so that timely, effective action can be taken."

Well, now, that is just one sort of an obvious conclusion drawn from this study of seven major industries, and I am sort of trying to get at how we can do that sort of thing. Do we have this capability at a high enough level of analyzing broad problems and focusing on them as they relate to the science and technology enterprise, so that we can more effectively utilize our great resources there?

Colonel Carter.

Colonel CARTER. Mr. Chairman, I might comment on a couple of areas there.

One is that I think there is a relationship that needs to be built in support of the universities, that is very important. If one looks at the decrease in scientists and engineering Ph.D. graduates at universities over the past 10 years, we are down.

If one also looks at the number of non-U.S. citizens that are going through our universities, they are up. One also has to look at a separate facet of the problem, I think, and that is that a change in attitude on the part of some of the university professors that, indeed, have engaged in pure science, as Mr. Bentley was describing earlier. It is not un-American to also perhaps make a profit by consulting with industry on some of the problems that industry has, and indeed, getting a good transfer of technology in that fashion.

There is another facet, too, I believe, and that is that if one looks at the number of students within particular curricula, one in particular that I think we need some enhancement in is manufacturing technology.

The number of students in manufacturing technology is not large, and that is an area that, to use some of the colloquialisms that Congressman Zschau used earlier, the other guys are eating our lunch in the manufacturing technology aspect.

If one looks at the overall structure of the Government insofar as providing the broad overview, in an open society such as ours, I think the possibilities are there. If you consider the development of the silicon chip, insofar as the initial defense research that went into developing the integrated circuit and all the work that was done on the silicon chip. In the beginning, the military used most of the products of that research. But as that technology became commonly available, we became a very minor user, and then I guess in about the late 1970's, we were only using about 7 percent of the capacity of integrated circuit production in the Nation. Quite frankly, we saw the business going in a direction that would not meet our needs, and we injected a little motivation to the direction through a program that we call very high-speed integrated circuits, in order to get the data throughput, that we need for systems that are of particular importance to us.

In pursuing that program, which has been very successfully accomplished, I believe, we have also created new ventures for the community. I am not sure that answers your question, either, but it is an interesting facet.

Mr. BROWN. Mr. Gillam.

Mr. GILLAM. Mr. Chairman, we are attacking, I believe, the philosophical question that you are asking about within NASA from two different points of view. We are attacking from the point of view of getting the technology that we have on the shelf transferred rapidly to the private sector, which we have testified about earlier.

However, the newly formed Office of Commercial Programs within NASA is also focusing on having the private sector set a portion of NASA's research agenda, so research that is promising for potential private sector application can be incorporated into our regular research program.

Over the last 61 years or so, NASA has had a great deal of success in working with an aeronautics model, which combines aspects of the aeronautics industry, the university community and the NASA research capabilities to keep the aeronautics industry, I think currently number two, in terms of balance of trade, second only to agriculture.

So, we are looking at the program from a point of view of trying to use that model to stimulate, one, the creation of new technology for U.S. industry; and second, to stimulate the rapid transfer of existing technology to U.S. industry so that it can become more competitive, and that is what we are doing within our organization.

We are working with other agencies on the larger philosophical question, but if you ask what we are doing inside, we are taking action in those two directions.

Mr. BROWN. Well, NASA has probably produced the most successful example of a commercial spinoff from a government program of any agency, and that is satellite communications industry and all of the things that are related to it. But I think you did that accidentally.

Mr. GILLAM. It was deliberate, sir. The program of demonstrating the synchronous communication satellite and communications satellite technology was aimed at potential application in the private sector.

Mr. BROWN. Then you backed out of the R&D on it for several years until we lost our lead, and then you got back into it?

Mr. GILLAM. But that was not deliberate, sir.

Mr. BROWN. That was an accident.

Mr. GILLAM. Right. That was an unforseen consequence.

Mr. BROWN. Congress was responsible for that.

Ms. Joseph.

Ms. JOSEPH. I would like to pass on the more philosophical part of your question, which I think really involves people who know more about the philosophy of the Federal Government role versus the private sector role, and that is probably key to it, but suggest, as others did, that the way we go about doing our business is aimed in part, at your overall objective. In the laboratories we have, essentially a multidisciplinary, interdisciplinary approach to problems. We conduct work for others, which means that we have national laboratories that carry out work for all Federal agencies. So you might have materials research, for example, done in a place like Oak Ridge National Laboratory funded by all of the agencies of the Government, including those with a mission orientation from the Department of Energy. And there, you are able to bring together a center of excellence that then becomes very attractive to the commercial sector, as well as having a university user facility orientation.

Another example would be something like the Sandia Research Center, which has, an advisory committee of people from the broad combustion research area, and the kinds of facilities and equipment that attract researchers from industry, from universities all over the country, and foreign researchers as well.

I think I am unable to answer your broader question even after describing these multidisciplinary centers of excellence which do have, as part of their role, the transfer of technology, why doesn't the Nation then have an effort to prioritize and promote and exploit an R&D area as a matter of policy in some kind of joint venture with the government and industry to make this an outstanding national technological accomplishment?

That is something beyond my area of expertise, but certainly, the seeds of that are part of what the Department of Energy is doing in its interaction with the private sector.

Mr. BROWN. Well, I appreciate the comments that all of you have made, and I have given you this opportunity as part of this continued commitment to breaking down the barriers that have existed in the past.

You know, we are stressing the need for these personal interactions between organizations, need for better cooperation between the various sectors here. There is also a need for breaking down some of the barriers that exist between those who at your level in the hierarchy, where you are, and very responsible positions which you still don't make overall policy for the government, and you can't, by nature of the situation that you are in.

But you should be prepared to think in terms of the overall policies that are needed for a successful generic policy in these areas, and I think we may get some of our best suggestions and recommendations from those who have direct experience with administering programs rather than those who come without direct experience, but with a philosophical or political bias of some sort that they want to reflect.

Well, we won't belabor that. We have taken a great deal of your time this morning, and we appreciate it very much. If we have additional questions, we will communicate them in writing, and you have one additional comment?

Mr. BENTLEY. Mr. Chairman, I think the National Research Council and the National Academy of Sciences, on their Roundtable of Government, Industry and Universities is attempting to address this point. They have four sub-task groups that deal with this. Representatives from each of all the agencies here are on that, are very active participants, and we are beginning to talk about these issues from the standpoint of competitiveness, the very thing that you spoke of; also, through some case studies, they are looking at some illustrations, and two that come to mind one in New Jersey and one in Pennsylvania, are real efforts to put together groups of this type, involving universities, designation of areas, and so on.

While that is a small step, that is an important one, I think, to give attention to this at a level that will get the attention, at least, I think, of the academic community, and many others as well, but certainly the academic community.

Mr. BROWN. Well, we have been grateful for the input of the various academies, and of the National Research Council. We have heard from them this week also, and last week, and their input has been extremely helpful to us.

I, perhaps, just might conclude the hearing by quoting again from this summary booklet. It says:

> Perhaps the most heartening conclusion that emerges is that the problems identified, and there were many of them, are amenable to solution within the context of our systems and values.

We are not suffering some inexorable decline, and I think we are in the process of making sure that we are going to not only not

suffer an inexorable decline, but we are going to show real progress in the near future.

Thank you very much for your comments.

Without objection, the documents submitted by the witnesses will be made a part of the record.

[Whereupon, at 12:40 p.m., the subcommittee was adjourned.]

APPENDIX I

ADDITIONAL STATEMENTS SUBMITTED FOR THE RECORD

IPO INTELLECTUAL PROPERTY OWNERS, INC.

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WASHINGTON, DC 20036
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Dow Chemical Co.
Midland, MI

Melvin P. Williams
United Technologies Corp.
Hartford, CT

EXECUTIVE DIRECTOR
Herbert C. Wamsley
Washington, DC

June 14, 1985

The Honorable Doug Walgren
Chairman
Subcommittee on Science, Research
and Technology
Washington, D.C. 20515

Dear Mr. Chairman:

Enclosed is a statement by Intellectual Property Owners, Inc. (IPO) on H.R. 695, the "Federal Laboratory Technology Utilization Act of 1985", and H.R. 1572, the "Federal Science and Transfer Act of 1985".

We hope your Subcommittee will find our statement helpful. We request that it be included in the record.

Sincerely,

Donald W. Banner

Donald W. Banner
President

DWB:jlh

Enclosure

cc: The Hon. Stan Lundine
The Hon. Norman Y. Mineta
The Hon. George E. Brown, Jr.
The Hon. Timothy E. Wirth
The Hon. Terry L. Bruce
The Hon. Tim Valentine
The Hon. Sherwood L. Boehlert
The Hon. Don Ritter
The Hon. Paul B. Henry
The Hon. William W. Cobey, Jr.

The Hon. Robert Dole
The Hon. Robert H. Michel

IPO INTELLECTUAL PROPERTY OWNERS, INC

STATEMENT BY INTELLECTUAL PROPERTY OWNERS, INC.

SUBMITTED TO THE SUBCOMMITTEE ON SCIENCE, RESEARCH AND DEVELOPMENT OF THE HOUSE SCIENCE AND TECHNOLOGY COMMITTEE

CONCERNING H.R. 695, THE "FEDERAL LABORATORY TECHNOLOGY UTILIZATION ACT OF 1985," AND H.R. 1572, THE "FEDERAL SCIENCE AND TECHNOLOGY TRANSFER ACT OF 1985"

Mr. Chairman and Members of the Subcommittee:

This statement expresses the views of Intellectual Property Owners, Inc. (IPO) concerning H.R. 695 and H.R. 1572.

Introduction.

IPO is a nonprofit association whose members own patents, trademarks, and copyrights. Our members include large corporations, small businesses, universities, and individuals. Our members are responsible for a significant portion of the research and development conducted in the United States. They operate numerous research laboratories which employ full-time inventors engaged in team research.

Federal laboratories should have clear authority to cooperate with other parties on R&D matters for mutual benefit. We support the basic objective of H.R. 695 and H.R. 1572 of encouraging the Federal laboratories to enter cooperative research and development arrangements with state and local governments, universities, and private companies.

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We therefore support in principle section 2 of H.R. 695 and section 2 of H.R. 1572.

We express no opinion on whether the current mix of basic research and applied research performed by Federal laboratories is optimal. It is often said that the primary role for the Federal government in research and development should be to do basic research and to work on long term or high risk projects where the likelihood of financial return is so remote that the private sector is unable to make the necessary investment.

By emphasizing cooperative research and development arrangements and the commercialization of inventions, H.R. 695 and H.R. 1572 may cause the Federal laboratories to de-emphasize basic research. Whether this is desirable is beyond the scope of our statement. Assuming that Federal laboratories should be doing research which has commercial potential, however, it seems to us that it is important for the laboratories to have adequate authority to enter into cooperative research and development arrangements with other organizations, public and private.

Royalty Sharing With Government Employees

We strongly oppose the royalty sharing requirement in section 3 of H.R. 695 and section 4 of H.R. 1572. These sections are concerned with distribution of royalties received by Federal laboratories from licensing of government-owned inventions to the private sector.

The sections would give Federal employees "at least 15 percent of the royalties or other income" when government-owned inventions made by the employees are licensed to the private sector. The bills thereby link compensation for Federal employees directly to the commercial success of government-owned inventions.

Based on the extensive experience of our member companies in managing inventors in a team research environment, we believe compensation schemes of this nature are unwise. Such compensation leaves no discretion for the managers of research teams to make judgments about the amount of compensation to be paid to their employees. This fundamentally changes the relationship between managers and employees.

The success of an invention in the market place depends not only upon the creative effort of the inventor, but also upon the efforts of research directors, production engineers, marketing personnel, and many others. Even fashion trends and consumer fads can be important factors in determining the success of an invention. We believe managers of research teams--whether Federal managers or private sector managers--are the people in the best position to judge the importance of the contributions made by the employees working in a research laboratory.

Teamwork among the employees in a research laboratory is vitally important. If only the "inventor" (i.e., the person named on the patent) is given financial rewards,

other team members become jealous and the exchange of ideas is inhibited. It has been the experience of our members that laws requiring special compensation for employee inventors in West Germany and certain other foreign countries do not improve productivity in research laboratories. A compensation formula decreed by a government is likely to reward inventors out of proportion to their contributions, with either too much compensation or too little.

Mr. Gerald J. Mossinghoff, then the U.S. Commissioner of Patents and Trademarks, last year opposed H.R. 3285, a bill which would have provided special compensation for both government employee inventors and private sector employee inventors. We agree with Mr. Mossinghoff's testimony opposing that legislation, which was somewhat similar in concept to section 3 of H.R. 695 and section 4 of H.R. 1572.

Federal managers already possess statutory authority to give substantial cash awards to their exceptional employees, including inventors. For example, 5 USC 4502 authorizes awards of up to $25,000 for inventions, suggestions, and other superior accomplishments. It is our understanding that some agencies, including the National Aeronautics and Space Administration, have authority to give larger awards than $25,000. We understand that some Federal agencies give such cash awards or bonuses regularly and find they are effective in helping motivate inventors and other scientific and technical personnel.

NASA, for example, has authority under 42 USC 2458 to make monetary awards to employees for scientific or technical contributions which have significant value in the conduct of aeronautical and space activities. The statute provides for an Inventions and Contributions Board to make recommendations to the Administrator of NASA concerning awards. The statute also gives guidance on factors to be taken into account in determining the nature of such awards.

If a need exists for additional incentives for Federal employee inventors beyond the $25,000 cash awards now available, we suggest that the Subcommittee should consider legislation similar to that in the NASA act.

In addition to the problems caused by compensating the inventors in proportion to the commercial success of their inventions, we believe the royalty sharing requirement in H.R. 695 and H.R. 1572 may have other undesirable effects.

We question the desirability of giving Federal employee inventors a financial stake in a policy of aggressive enforcement of government-owned patents. The royalty sharing requirements in H.R. 695 and H.R. 1572 could cause government inventors to urge government attorneys to file more infringement suits against private companies, because in effect the bills would give government inventors free legal representation.

In addition, government employees might be encouraged by the bills to urge Federal agencies to file more patent applications. The government already is filing unneeded

applications and is the owner of more unexpired U.S. patents than any other entity. Congress last year enacted legislation to give agencies the option to save money and relieve some of the burden on the Patent and Trademark Office by obtaining statutory invention registrations instead of patents. (Public law 98-622.) Agencies will be unlikely to elect statutory invention registrations if the royalty sharing requirement is included in the legislation.

Finally, we are concerned that enactment of section 3 of H.R. 695 or section 4 of H.R. 1572 would be viewed as a precedent justifying similar legislation covering private sector employee inventors. American industry strongly opposes legislation which would mandate special compensation for the private sector's employee inventors. It seems to us that in principle the incentives used to motivate inventors in Federal laboratories are the same as incentives used to motivate inventors in private laboratories: salary, benefits, bonuses, and professional recognition. We know of no rationale for why the royalty sharing requirement could be a bad idea for private businesses but a good idea for government agencies.

For these reasons, we urge the Subcommittee to delete the provision on royalty sharing entirely or replace it with a provision on bonuses.

Section 5 of H.R. 695--Conflicts of Interest; Employee Ownership of Inventions

We also urge deleting section 5 of H.R. 695, on "Employee Activities". H.R. 1572 contains no corresponding section.

Subsection 5(a) exempts Federal employee inventors from key provisions of Chapter 11 of Title 18 of the United States Code, which deals with conflicts of interest. We believe this exemption is totally unwarranted. We can see no reason for exempting inventors from the conflict of interest rules which apply to other government employees. Such an exemption may well encourage conflicts of interest and cause harm to the public. Inventors should not be held to a lower standard than other employees.

The exemption in Section 5(a) could lead to problems both with respect to former employees and with respect to present employees. Subsection 5(a) seems to remove all restrictions on former employees negotiating with their former colleagues for cooperative research and development arrangements which would give them substantial monetary benefits with respect to inventions they made while employed by the government. The subsection waives the prohibition against former employees appearing before their former agencies, "with the intent to influence," on matters in which the employee "participated personally and substantially as an officer or employee". 18 USC 207(a).

It also waives the prohibition against attempting to influence the agency for a period of two years after employment has ceased on a matter "which was actually pending under his official responsibility as an officer or employee...." 18 USC 207(b).

Subsection 5(a) also would remove restrictions on a present employee participating in a private company which enters a cooperative research and development arrangement with the agency relating to the employee's invention. The subsection, in waiving 18 USC 208, seems broad enough to sanction an employee making the decision, or participating in the decision, in his government capacity, on whether the government should enter into a research and development arrangment with him in his private capacity. This obviously is contrary to the public interest.

We also question the desirability of section 5(b) of H.R. 695, which gives government employees or former employees who made an invention on government time and with government funds the right to ownership of the invention "unless the agency intends to file for a patent application in order to promote commercialization of the invention". Subsection 5(b) appears to go beyond Executive Order 10096, which sets forth the existing government policy on ownership of inventions by government employees. Executive Order 10096, although it contains exceptions, establishes the following basic policy:

> The Government shall obtain the entire right, title, and interest in and to all inventions made by any Government employee (1) during working hours, or (2) with a contribution by the Government of facilities, equipment, materials, funds, or information, or of time or services of other Government employees on official duty, or (3) which bear a direct relation to or are made in consequence of the official duties of the inventor.

Subsection 5(b), if read literally, gives government employees ownership of inventions made at taxpayer expense which have immediate commercial value, if the agency does not file a patent application. The subsection is in direct conflict with Executive Order 10096, because it gives the government employee an absolute right to demand ownership of some inventions even where the inventor's salary and expenses during the development of the invention were paid for entirely by the government. We believe the Subcommittee should not approve legislation altering longstanding Executive Order 10096 without much more careful analysis of the ramifications.

For these reasons, we recommend dropping section 5 of H.R. 695.

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We hope your Subcommittee finds these comments useful.

National Association
of Manufacturers

Resources and Technology
Energy
Environmental Affairs
Natural Resources
Innovation, Technology & Science Policy

June 12, 1985

The Honorable Doug Walgren
Chairman
Subcommittee on Science, Research
and Technology
U.S. House of Representatives
Washington, DC 20515

Dear Chairman Walgren:

The National Association of Manufacturers supports the broad objectives of H.R. 695, the Federal Laboratory Technology Utilization Act of 1985. However, there is one section in the bill, Sec. 3(a)(1), which concerns the NAM Task Force on Intellectual Property. They have studied it carefully and discussed it with representatives of the Department of Commerce in a frank and open exchange of views.

We support the concept that innovation teams employed by the government be rewarded for specially meritorious work. Government research or innovation teams should be rewarded in cases where government technology is commercialized or where government technology is in the form of particularly valuable fundamental or basic research, even if it cannot readily be commercialized in the short term. We agree with the concept that useful government technology should be licensed. We also agree that licensing can be on a royalty-bearing basis and that any royalties generated be put into a special fund rather than into the Treasury Department. However, the use of this royalty fund in the particular manner called for by H.R. 695 gives us concern.

What gives us concern is the requirement that a specific portion of royalties generated be paid to the legally-named inventors on government patents. We believe this approach to rewarding government inventors would have an adverse affect on the entire research or innovation process and is significantly inequitable. Moreover, there are extremely difficult administrative problems in such a plan such as deciding who the specific inventor was or whether others were involved in the invention. Therefore, NAM urges that Section 3(a)(1), specifying that at least 15 percent of royalties be awarded to the inventor, be deleted.

The proposal in Section 3(a)(1) is not equitable. In modern team

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research there are three important elements: The first phase is the pre-invention activity which involves such important matters as identification of the problem to be solved; staffing decisions; managerial directions and assignments; and providing facilities. The second phase is the actual invention, often made by the persons to whom the project manager has assigned the problem. These are the persons who are named on the patents, and properly so, but they only contribute a portion, albeit important, of the entire innovation process. The third phase is the post-invention activity which involves safety testing; commercial feasibility; testing the invention; scale-up; and prototype refinement. To single out only the legal inventors is inequitable and counter-innovative because it would result in secrecy, jealousy, poor communications and loss of the important concept of teamwork.

Section 3(a)(1) would risk a major distortion, that of emphasizing government R&D having only short-term, high commercial potential at the expense of long-term, fundamental, basic research. This is of great concern to private industry which looks to the government and universities to do basic research having long-term potential. Basic research skills represent an important economic advantage that the United States still has over its competitor countries. Section 3(a)(1) could risk reduction of these skills.

The concept of a fixed share also presents equity problems because the patent may be a key factor in the royalty income or may be only a minor factor. Often technology is licensed as a package, with some patent rights and some know-how. We can see that government licensing could present the same problems. The licensed patent may be break-through, pioneering type or involve a very minor incidental aspect of the licensed technology where the most valuable portion is the know-how generated by others on the innovation team. A common way of licensing is on a running royalty basis. This is a satisfactory way for the government to license its technology, but not a satisfactory way to reward one or two or three individuals.

Section 3(a)(1) also suggests possible conflicts of interest. Should an inventor employed by the government be permitted to use government time and resources to promote, or otherwise participate in the licensing of technology in which the inventor has a personal interest?

Many industrial research organizations use bonuses to reward meritorious innovations. Bonuses permit rewards based on the relative contribution of all members of a research or innovations team, not just those few who happen to be legal inventors. The

experience of these organizations suggests that the flexibility to tailor the reward to each particular situation is a very important consideration.

Non-government research organizations are concerned that the mandatory rewarding of employed inventors using the approach of Section 3(a)(1) would set an unfortunate precedent and would risk reintroduction and passage of legislation of the type proposed by Rep. Robert Kastenmeier in prior Congresses.

We urge you to seek modification of H.R. 695 so as to provide a discretionary awards system for research and innovation teams in place of the mandatory "piece-of-the-action" plan which is inequitably limited to the legal inventors.

Sincerely,

Richard C. Witte pp.

Richard C. Witte
Chairman, NAM Task Force
on Intellectual Property
(Chief Patent Counsel,
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The American Society of Mechanical Engineers

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May 31, 1985

Honorable Doug Walgren
Chairman
Subcommittee on Science, Research
and Technology
Committee on Science and Technology
2319 Rayburn House Office Building
Washington, D.C. 20515

Dear Mr. Chairman:

The American Society of Mechanical Engineers appreciates this opportunity to present its views on transfer and commercial utilization of technology developed by Federal Laboratories. We request that the enclosed statement be included in the record of the hearings on technology transfer conducted by the Subcommittee on Science, Research and Technology, May 21-22, 1985 on technology transfer.

We hope this statement is useful to the Subcommittee as it reviews Federal policy on technology transfer. Please let us know if we can provide further information or can be of assistance.

Sincerely,

George Kotnick
President

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Statement of
The American Society of Mechanical Engineers

Mr. Chairman and Members of the Subcommittee:

The American Society of Mechanical Engineers is pleased to provide its views on the transfer and commercial utilization of technology developed by Federal Laboratories, agencies and research contractors.

ASME is a technical society with some 111,000 individual engineer members. the Society has 35 technical divisions, sponsors or co-sponsors over 30 national conferences on technology each year, and is one of the largest technical publishers in the world.

ASME has members in Federal labs and agencies, as well as State and local governments. However, the vast majority of our members are in industry. Therefore, our comments should be largely considered as being from the perspective of users or potential users of federally funded research.

While the concept of technology transfer is old, the importance of the practice has increased dramatically in recent years due to a rapid escalation of new scientific and technical knowledge.

We believe that the practice of technology transfer has been sorely neglected by both the public and private sectors, and that unless steps are taken to correct the problem, the U.S. industrial productivity, international competitiveness and econonic growth will fall short of their potential.

Therefore, we strongly endorse a strengthening of the Stevenson-Wydler Act as well as initiation of additional initiatives to foster technology transfer.

Specifically, we recommend the following:

1. Elevate the priority of technology transfer as a functional responsibility for all Federal Laboratories and agencies with significant research and development budgets.

Laboratory directors and agency heads should be required to make annual reports to Congress on their technology transfer programs. Congress should hold regular oversight hearings on department and agency technology tranfer programs.

Line iten budgets for technology transfer should be established at each lab and affected agencies. Each lab and agency should have an identifiable office of technology utilization staffed by full time technology transfer agents.

2. Federal labs and agencies should elevate the status of their technology tranfer agents. To reflect setting a higher priority for technology transfer, labs and agencies should recognize the importance of filling the technology transfer jobs with high-level, experienced technology transfer agents. These agents must have broad knowledge not only about their lab or agency research products, but also about other resources necessary for effective technology utilization, including financial, legal and marketing resources. The agents must also be of the stature to effectively interact with corporate vice presidents and officials in State and local governments and universities who might have the final word on a prospective technology utilization project.

3. Stevenon-Wydler should give highest priority to technology tranfer and utilization. Under the present fiscal constraints, we suggest that the Act concentrate on technology transfer, including funds for the Federal Laboratory Consortium and studies outlined below rather than funding the Section 6 Centers for Industrial Technology. Similar centers such as the Engineering Research Centers and other cooperative research efforts are already being supported by the National Science Foundation. In addition, many university-state-industry programs are well underway without direct federal support.

4. Encourage Federal Laboratories and agency technology transfer programs to initiate aggressive outreach programs. Many private sector organizations, technical consultants, and State agencies concerned with economic development are not aware of the resources available at Federal labs. Meetings around the country, cooperation with the Small Business Administration, universities, and state and local governments, and other outreach programs are needed.

Increased publicity about technology transfer successes might provoke greater private sector interest in exploring Federal lab resources. The "not invented here" syndrome at some companies might be broken down if they believe they are missing real opportunities.

5. Strengthen and broaden the scope of the Federal Laboratory Consortium (FLC). There should be more user interaction with the FLC. Technology transfer agents should not only be talking to one another but with

representatives of private industry, universities and State and local governments. This might be done through workshops, committees, and so on. FLC should, at a minimum, receive government funding to enable it to participate in and sponsor meetings.

6. Establish a National Commission on Technology Transfer and Utilization

The Congress should establish a two-year Commission on Technology Transfer and Utilization to help elevate the awareness of technology transfer, to study institutional barriers and to make policy recommendations to Congress. More specifically, the Commission should study issues such as why corporations and universities are not more aggressive in utilizing federally-funded research results; what are the barriers to more effective technology transfer and what incentives are appropriate? The Commission should consist of members of Congress, the President's Science Advisor, Federal Laboratory and agency heads, and representatives from corporations, universities, state government, technical societies and other interested groups.

7. Mandate a study by a technical society or other appropriate organization to examine the art and practice of technology transfer. Many technology transfer agents or people who perform that role have no training or background in the field. What types of background and training would help provide more effective technology transfer agents? What should a technology tranfer agent do to be affective? What methodologies are most effective?

8. Encourage streamlining of technology tranfer processes and extend R&D tax credits to help encourage private sector risk taking. It is critical to

recognize that even a strengthened Stevenson-Wydler Act will be limited to providing the framework for labs to transfer information on inventions and technology. It is still largely up to the private sector to take the time and money to apply and commercialize the technology.

Many companies and individual entreprenuers sinply do not have the patience to deal with government red tape. Even where procedures have been streamlined, many private sector groups assume the worst and don't bother to invest the time and money to deal with government. Every effort should be made to help break down this barrier by making it as easy as possible for the private sector to utilize federally funded research. Attempts to commercialize inventions are costly, risky ventures and companies do not need the added frustration and cost of time delays associated with government red tape.

We also support extension of the Federal tax credits for research and development as a Federal policy demonstrating support for private sector research and development efforts. With most inventions taking a minimum of 10-15 years to commercialize and the high risks involved in product development, the government should not send a negative signal to the private sector by failing to extend the R&D tax credits.

9. Formalize the authority of Federal labs to enter into cooperative agreements with industry and universities, and provide incentives for them to do so. We support legislation to accomplish this objective such as the Federal Laboratory Technology Utilization Act (S. 65) sponsored by Senate Majority Leader Robert Dole, and the House counterpart, H.R. 695 introduced by

House Minority Leader Robert H. Michel. Decentralization of the day to day management of technology should help to encourage an entrepreneurial spirit in the Federal Labs and give the labs the necessary flexibility to work more closely with industry, universities and State and local government.

10. Extend patent and licensing rights under federal research to all entities, including large corporations. Presently, universities, nonprofit organizations and small business have rights to title of inventions developed with federal funding. These are important rights and should be extended to large companies as well. Successful commercialization of inventions usually requires 10-15 years of dedication, ability to absorb losses, and large product development investments. In many cases, only large corporations will have these necessary resources. Therefore, we believe technology transfer and utilization of federally funded research would benefit from a uniform patent and licensing law such as proposed in S.64 by Senate Majority Leader Robert Dole.

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NCST

NATIONAL COALITION FOR SCIENCE AND TECHNOLOGY

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TESTIMONY OF THE NATIONAL COALITION FOR SCIENCE & TECHNOLOGY

on

TECHNOLOGY TRANSFER LEGISLATION

Submitted to the

HOUSE SUBCOMMITTEE ON SCIENCE, RESEARCH AND TECHNOLOGY

MAY, 1985

MR. CHAIRMAN AND MEMBERS OF THIS DISTINGUISHED COMMITTEE, I AM BRETT BERLIN, CHAIRMAN OF THE BOARD OF THE RECENTLY CHARTERED NATIONAL COALITION FOR SCIENCE AND TECHNOLOGY (NCST) EDUCATION FOUNDATION AND A MEMBER OF THE NCST ADVISORY BOARD. NCST IS A BROAD AND GROWING NON-PARTISAN NON-PROFIT COALITION WHICH SEEKS TO DEVELOP AND PROMOTE POLICIES THAT WILL HELP SECURE THE RESEARCH AND DEVELOPMENT, EDUCATION, CAPITAL, AND ORGANIZATION INFRASTRUCTURE NEEDED TO SUSTAIN LONG-TERM U.S. EXCELLENCE IN SCIENCE, ENGINEERING, AND TECHNOLOGY. NCST MEMBERS INCLUDE RESEARCH SCIENTISTS, ENGINEERS, EDUCATORS, CORPORATE REPRESENTATIVES, AND OTHER CITIZENS AS WELL AS CORPORATIONS.

THANK YOU FOR THIS OPPORTUNITY TO DELIVER NCST VIEWS ON THE PROPER ROLE OF THE FEDERAL GOVERNMENT IN PROMOTING AND FACILITATING THE TECHNOLOGY INNOVATION ESSENTIAL TO MAINTAINING AMERICA'S INDUSTRIAL COMPETITIVENESS. WE OF NCST SHARE YOUR COMMITMENT TO IDENTIFYING AND IMPLEMENTING A SET OF POLICIES THAT CAN BOTH MAXIMIZE THE OPPORTUNITIES THAT FEDERAL RESOURCES CAN PROVIDE WHILE MINIMIZING THE SUBTLE, AND OFTEN VERY HARMFUL NEGATIVE EFFECTS THAT TEND TO ACCOMPANY QUICK FIXES AND "OBVIOUS" SOLUTIONS. WE ALSO RECOGNIZE THE FISCAL REALITIES POSED BY THE LARGE BUDGET DEFICIT AND ARE COMMITTED TO HELPING THE COMMITTEE IN ANY WAY WE CAN IN ITS TASK OF ENSURING THAT WHATEVER FUNDING IS RECOMMENDED FOR TECHNOLOGY INNOVATION PROGRAMS ARE CAREFULLY REVIEWED TO ENSURE MAXIMUM LEVERAGE OF SCARCE TAXPAYER DOLLARS. FINALLY, LOOKING BEYOND THIS YEAR'S DEFICIT TO THE FUTURE, WE STRONGLY SUPPORT AGGRESSIVE LEADERSHIP AND FUNDING OF THE HEARTBEAT OF AMERICA'S FUTURE INDUSTRIAL COMPETITIVENESS: BROAD BASED RESEARCH

AND DEVELOPMENT AND PRAGMATIC COOPERATION BETWEEN FEDERAL LABORATORIES, UNIVERSITIES AND THE ENTREPRENUREAL PRIVATE SECTOR.

TESTIMONY OVERVIEW

THE SPECIFIC OBJECTIVE OF THIS TESTIMONY, AS REQUESTED BY THE COMMITTEE, IS TO ADDRESS ISSUES AND TO MAKE RECOMMENDATIONS RELEVANT TO THE POTENTIAL REAUTHORIZATION OF THE STEVENSON-WYDLER INNOVATION ACT OF 1980. IN SUPPORT OF THAT OBJECTIVE, WE HAVE CHOSEN TO COMMENT IN THREE BROAD AREAS. FIRST, WE DISCUSS THE INHERENT ROLES WHICH WE BELIEVE THAT THE FEDERAL GOVERNMENT HAS IN THE TECHNOLOGY INNOVATION PROCESS. BY "INHERENT", WE MEAN THAT THERE ARE CERTAIN ROLES THAT THE GOVERNMENT HAS REGARDLESS OF WHAT LEGISLATION EMANATES FROM THIS OR SIMILAR DELIBERATIONS. THESE ROLES FORM A NATURAL BASIS FOR POLICY THAT CAN LEVERAGE CURRENT FEDERAL RESEARCH DOLLARS INTO MAJOR INVESTMENTS IN AMERICA'S INDUSTRIAL FUTURE. THE NATION MUST MOVE AGGRESSIVELY IN THESE FRONTS AS A FIRST STEP TO ANY INNOVATION POLICY; NCST BELIEVES THERE IS A NATIONAL CONSENSUS TO DO SO.

IN THE SECOND SECTION OF OUR TESTIMONY, WE DISCUSS SOME OF THE DETAILS OF THE ACT AND MAKE SOME RECOMMENDATIONS CONCERNING ITS REAUTHORIZATION. WE BELIEVE THAT THE ACT IS MAKING A CONTRIBUTION AND SHOULD BECOME THE BASIS FOR FOLLOW-ON LEGISLATION WHICH CAN KEEP THE MOMENTUM GOING. THE ACT HAS HELPED FOCUS ATTENTION UPON THE NEED FOR AN ENVIRONMENT CONDUCIVE TO TECHNOLOGY TRANSFER, INNOVATION, AND COMMERCIALIZATION. IT HAS ALSO PROVIDED AN "UMBRELLA" FOR SOME

ACTIVITIES THAT, WHILE NOT SPECIFICALLY MANDATED BY THE ACT, WERE IN THE SPIRIT OF THE ACT AND MADE SENSE. THE NEXT STEP NEEDS TO CONTINUE IN THESE DIRECTIONS. FURTHERMORE, WHILE MAJOR NEW FUNDING IS UNLIKELY THIS YEAR, THE ROLE OF THE DEPARTMENT OF COMMERCE AS THE LEADING AGENCY FOR GOVERNMENT POLICY IN SUPPORT OF AMERICAN TECHNOLOGY INNOVATION NEEDS TO BE SUPPORTED.

FINALLY, WE SUGGEST SOME INITIATIVES THAT MIGHT HELP THE PROCESS INTENDED BY THE ACT BUT WHICH MAY REQUIRE OTHER LEGISLATION ACTION TO ACCOMPLISH.

INHERENT FEDERAL ROLE IN TECHNOLOGY INNOVATION

THE STEVENSON-WYDLER ACT PROVIDED FOR A NUMBER OF SPECIAL PROGRAMS BY WHICH THE FEDERAL GOVERNMENT MIGHT ENHANCE ITS ROLE OF ENCOURAGING INNOVATION AND COMMERCIALIZATION. THESE TYPES OF PROGRAMS WILL BE DISCUSSED IN MORE DETAIL IN THE NEXT SECTION OF THIS TESTIMONY. HOWEVER, BEFORE EVEN CONSIDERING THE ACT AND RELATED INITIATIVES, IT IS CRITICAL THAT WE PAUSE TO PUT THE ACT WITHIN THE BROADER CONTEXT OF THE TOTAL FEDERAL ROLE. THE FEDERAL GOVERNMENT HAS THREE MAJOR "INHERENT" ROLES IN FOSTERING TECHNOLOGY INNOVATION.

1. SPONSOR INNOVATION TO MEET MISSION REQUIREMENTS

THE FIRST, AND MOST DIRECT ROLE, IS THE "SPONSORSHIP" OF INNOVATION AND COMMERCIALIZATION IN ORDER TO MEET DEFINED MISSION REQUIREMENTS. THE SPACE PROGRAM WAS A PRIME EXAMPLE. THE

PURPOSE OF THAT PROGRAM WAS TO PUT A MAN ON THE MOON, NOT TO SPAWN INNOVATION. BUT THE RESULT WAS A MASSIVE RESURGENCE OF INNOVATION THAT CHANGED THE FACE OF OUR NATION AND THE WORLD.

WHILE CERTAINLY CONTROVERSIAL FOR MANY POLITICAL AND SIGNIFICANT REASONS, THE STRATEGIC DEFENSE INITIATIVE AND THE SPACE STATION PROGRAMS, COULD BE KEY INNOVATION DRIVERS FOR THE NEXT DECADE. BOTH PROGRAMS REQUIRE SUBSTANTIAL BASIC RESEARCH AND INNOVATION WHICH WILL BE USEFUL ACROSS A BROAD SPECTRUM OF APPLICATIONS. BOTH ARE ALSO LONG TERM IN NATURE AND ARE FOCUSED ON A MISSION, RATHER THAN A TECHNOLOGY OBJECTIVE. BOTH WILL HEAVILY UTILIZE SOME OF OUR MOST VALUABLE TALENT -- UNIVERSITY BASED RESEARCHERS -- AND WILL TEND TO BRING THEM NATURALLY TOGETHER WITH INDUSTRY AND FEDERAL LABORATORIES. AND FINALLY, BOTH WILL RESULT IN ESSENTIALLY "OPEN" RESEARCH. (I SHOULD STATE AT THIS POINT THAT THIS DISCUSSION DOES NOT IMPLY THAT NCST IS TAKING A POLITICAL POSITION ON THESE TWO PROGRAMS. AS WOULD BE EXPECTED, OUR MEMBERSHIP HAS WIDELY DISPERSED VIEWS, AND MANY LEGITIMATE CONCERNS AS TO THE IMPACT THESE PROGRAMS COULD HAVE. WHAT WE ARE POINTING OUT, HOWEVER, IS THAT THESE PROGRAMS ARE EXCELLENT EXAMPLES OF THE POTENTIAL POWER OF THE FEDERAL ROLE IN SPONSORING INNOVATION TO MEET SPECIFIC MISSION NEEDS).

ON A SMALLER SCALE, THERE ARE MANY PROGRAMS WHICH NATURALLY ENCOURAGE INNOVATION. THERE ARE ALSO SOME IMPORTANT MECHANISMS IN PLACE THAT TEND TO FOSTER THE TYPE OF INNOVATION ENVISIONED BY STEVENSON-WYDLER. THESE INCLUDE, FOR EXAMPLE, THE SMALL BUSINESS

INNOVATIVE RESEARCH PROGRAM, THE DOD INDEPENDENT RESEARCH AND DEVELOPMENT (IR&D) PROGRAM, THE MULTI-STAGE COMPETITIVE ACQUISITION PROCESS, AND THE ENCOURAGEMENT OF AGENCIES TO CONTRACT OUT BY REGULATIONS SUCH AS OMB CIRCULAR A-76.

THE IMPORTANCE OF THIS DIRECT AND NATURAL FEDERAL ROLE CANNOT BE UNDER-EMPHASIZED. AMERICAN LEADERSHIP IN SUPERCOMPUTER TECHNOLOGY DEMONSTRATES THIS FACT. WHILE MANY SEE OUR LEADERSHIP IN THIS AREA AS A RESULT OF BETTER RESOURCES OR PEOPLE, I FIRMLY BELIEVE THAT AMERICA LEADS THE PACK BECAUSE WE HAVE THE PROBLEMS TO SOLVE AND HAVE DECIDED TO SOLVE THEM. THE RESULT IS A WELL-DEFINED SET OF USERS WHO HAVE FORMED A CONSISTENT CUSTOMER BASE TO WHOEVER WANTED TO BUILD THE MOST POWERFUL COMPUTERS, AS WELL AS AN EFFECTIVE TEST BED FOR EACH NEW SUPERCOMPUTER GENERATION. THIS CLIMATE PROVIDES BOTH THE MECHANISM AND THE INCENTIVE FOR EFFECTIVE TECHNOLOGY INNOVATION.

2. SPONSOR INNOVATION BY FUNDING BROAD BASIC RESEARCH

THE SECOND INHERENT ROLE OF THE FEDERAL GOVERNMENT THAT HAS DEVELOPED OVER THE YEARS IS THAT OF FUNDING LARGE BASIC RESEARCH PROGRAMS AIMED AT BUILDING THE COUNTRY'S TECHNOLOGY BASE. THIS COMMITTEE, AS WELL AS THE CURRENT ADMINISTRATION, HAS BEEN A SUPPORTER OF THE BIPARTISAN EFFORTS TO ENSURE CONTINUED FUNDING OF THESE INVESTMENTS IN THE FUTURE DESPITE THE CUTS IN OTHER PROGRAMS. WE OF NCST COMMEND THOSE WHO WILL TAKE THE FAR-SIGHTED VIEW THAT OUR BASIC RESEARCH IS THE "SEED CORN" FOR THE NEXT

GENERATION. WE MUST, EVEN IN DIFFICULT BUDGET YEARS, CONTINUE THE AGRESSIVE REBUILDING OF OUR RESEARCH AND TECHNOLOGY BASE.

IF TECHNOLOGY INNOVATION IS TO FLOURISH IN THE FUTURE, WE MUST PAY CONTINUAL ATTENTION TO OUR BASIC RESEARCH PROGRAM TO ENSURE (1) LONG-TERM CONSISTENCY, BOTH IN PROGRAM DIRECTIONS AS WELL AS FUNDING, (2) BROAD DISPERSAL ACROSS THE COUNTRY WHENEVER PRACTICAL, AND (3) TRANSFERABILITY TO THE CIVILIAN SECTOR ECONOMY, EVEN IF THE ORIGINAL FUNDING CAME IN SUPPORT OF A DEFENSE PROGRAM. NOW, MORE THAN EVER BEFORE, WE MUST LOOK TO DEVELOP A SYNERGISM THAT WILL ALLOW US TO UTILIZE BOTH OUR NATIVE TALENT AND ALL FEDERAL RESEARCH DOLLARS AS AN INVESTMENT IN OUR OVERALL ECONOMIC FUTURE.

3. SPONSOR INNOVATION BY FOSTERING ENTREPRENUREAL CLIMATE

THE FINAL, AND FROM A NEW POLICY POINT OF VIEW THE MOST URGENT AT THIS TIME, IS THE FEDERAL ROLE IN FREEING THE AMERICAN ENTERPRISE SYSTEM TO SPAWN AND SUSTAIN ENTREPRENUREAL ACTIVITY. NO PROGRAM WILL ENCOURAGE THE TYPE OF INNOVATION ENVISIONED BY STEVENSON-WYDLER MORE EFFECTIVELY OR WITH LESS FEDERAL EXPENSE THAN A PROGRAM DESIGNED TO REMOVE THE FISCAL AND BUREAUCRATIC HANDCUFFS FROM THOSE WHO WOULD OTHERWISE LEAD THE REVOLUTION.

PUT DIRECTLY, MR. CHAIRMAN, THE FOUNDATION FOR ALL TECHNOLOGY INNOVATION THAT HELPS AMERICA COMPETE IN WORLD MARKETS IS THE MAINTENANCE AND STRENGTHENING OF THE ENTREPRENUREAL CLIMATE AND

THE CAPITAL FORMATION MECHANISMS ESSENTIAL TO TRANSFORM A GOOD IDEA INTO JOBS. TECHNOLOGY TRANSFER PROGRAMS CAN BE PERFECT, RESEARCH AND DEVELOPMENT CAN BE ABUNDANTLY FUNDED, AND WE CAN KNOW ALL THERE IS TO KNOW ABOUT THE POTENTIAL MARKETS FOR OUR INNOVATION. BUT IF OUR POLICIES DO NOT ENCOURAGE AND REWARD THE RISKS THAT ACCOMPANY BOLD APPLICATION OF OUR TECHNOLOGY, THEN WE WILL NEVER REAP THE TRUE REWARDS OF OUR LABOR. THIS COMMITTEE IS WELL VERSED ON THE ISSUES OF WHICH WE SPEAK, AND WE CANNOT DEAL IN DETAIL WITH ANY ONE OF THEM TODAY. HOWEVER, FOR THE RECORD, NCST STRONGLY ENCOURAGES THE COMMITTEE TO CONTINUE ITS EFFORTS IN AT LEAST THE FOLLOWING AREAS, ALL OF WHICH WERE ADDRESSED IN THE RECENT REPORT OF THE PRESIDENT'S COMMISSION ON INDUSTRIAL COMPETITIVENESS:

CAPITAL FORMATION: THE AMERICAN ENTREPRENUREAL PROCESS IS TOTALLY DEPENDENT UPON AVAILABILITY OF VARIOUS FORMS OF VENTURE CAPITAL. MANY PROPOSALS FOR "TAX REFORM" CALL FOR INCREASES IN CAPITAL GAINS AND OTHER VENTURE-RELATED TAXES, WHILE ALSO INCREASING CORPORATE TAXES IN SUCH MANNER AS TO EXACERBATE ALREADY EXISTING DIFFERENTIALS IN THE EFFECTIVE TAX RATES BETWEEN INDUSTRIES. FOR EXAMPLE, CRAY RESEARCH, THE WORLD LEADER IN SUPERCOMPUTER TECHNOLOGY ALREADY PAYS AN EFFECTIVE TAX RATE IN EXCESS OF 42% -- MORE THAN MOST INDIVIDUAL TAX PAYERS.

RESEARCH AND DEVELOPMENT TAX INCENTIVES: THE CURRENT TAX CREDIT PROVISIONS ENACTED IN 1981 WILL EXPIRE THIS YEAR

UNLESS CONGRESS TAKES ACTION NOW. THESE INCENTIVES NOT ONLY ARE CONSIDERED A KEY ELEMENT IN CORPORATE DECISION MAKING RELATIVE TO NEW RESEARCH, BUT AS CURRENTLY PROPOSED THEY WILL PROVIDE STRONG INCENTIVES FOR INCREASED DIRECT "CORPORATE-UNIVERSITY PARTNERSHIP".

STABLE TRADE ENVIRONMENT: RECENT DISCUSSIONS OF POSSIBLE "TRADE WARS" WITH OUR ALLIES POINT TO THE DANGERS INHERENT IN OUR CURRENT SITUATION. WHILE IT IS IMPORTANT THAT WE PRESS FOR "FAIR TRADE" WITH ALL OF OUR ALLIES, PROTECTIONIST LEGISLATION COULD QUICKLY UNDERMINE OUR ABILITY TO COMPETE BOTH AT HOME AND ABROAD.

FEDERAL SPENDING CONTROLS: NCST STRONGLY SUPPORTS EFFORTS TO BRING THE FEDERAL DEFICIT UNDER CONTROL. WE RECOGNIZE THAT HARD DECISIONS MUST BE MADE IN ORDER TO REDUCE THIS DEFICIT. FOR SEVERAL YEARS, WE HAVE LIVED WITH TIGHT BUDGETS IN THE SCIENTIFIC, ENGINEERING, AND TECHNICAL COMMUNITIES. ACROSS THE BOARD THE "BURDEN OF PROOF" MUST BE PLACED ON THOSE WHO WOULD DEFEND AGAINST SOME CUTS. FURTHERMORE, WE ENCOURAGE THE COMMITTEE TO LOOK FOR OPPORTUNITIES TO ENCOURAGE AGENCIES TO WORK WITH ONE ANOTHER TO ENSURE THAT INNOVATIONS DEVELOPED FOR ONE FEDERAL MISSION ARE TRANSFERRED TO OTHER AGENCIES. THE PRESIDENT'S SCIENCE ADVISOR HAS PROVIDED SOME LEAD IN THIS AREA BY SPONSORING INTERAGENCY GROUPS SUCH AS THE FEDERAL COORDINATING COMMITTEE ON SCIENCE, ENGINEERING, AND TECHNOLOGY (FCCSET).

THIS TYPE OF "AD HOC" INITIATIVE IS TO BE COMMENDED BOTH BECAUSE IT MAKES SENSE AND BECAUSE IT CAN HELP US STRETCH ALREADY SCARCE BUDGET DOLLARS.

GOVERNMENT REORGANIZATION: DURING THE LAST SEVERAL YEARS A NUMBER OF MAJOR REORGANIZATION PROPOSALS HAVE BEEN PROFFERED AS POTENTIAL "SOLUTIONS" TO SOME OF THE DIFFICULT PROGRAMS FACING US IN TECHNOLOGY INNOVATION, TRADE, EDUCATION, ENERGY, ETC. MOST RECENTLY, THE PRESIDENT'S COMMISSION PROPOSED ESTABLISHING TWO NEW DEPARTMENTS: TRADE, AND SCIENCE AND TECHNOLOGY. WHILE BOTH PROPOSALS HAVE CONSIDERABLE MERITS, A PRAGMATIC VIEW OF REALITY TELLS US THAT REORGANIZATION WILL NOT CAUSE DIFFICULT PROBLEMS TO DISAPPEAR OVERNIGHT. NCST STRONGLY ENCOURAGES, THEREFORE, DEALING WITH THE "HARD" ISSUES MORE DIRECTLY FIRST.

EDUCATION: THE PRESIDENT'S COMMISSION IDENTIFIED SEVERAL PRIORITY PROGRAMS AND ISSUES RELATED TO EDUCATION. NCST STRONGLY ENDORSES ANY EFFORTS TO STRENGTHEN THE QUALITY OF EDUCATION IN THIS COUNTRY. IN FACT, THE NCST MEMBERSHIP SO STRONGLY ENDORSES THE NEED FOR BETTER EDUCATION THAT WE HAVE FORMED THE NCST EDUCATION FOUNDATION.

THE POLICY ISSUES ADDRESSED ABOVE DEAL WITH THE BROAD ENVIRONMENT - THE "LIFE SUPPORT SYSTEM" OF ENTREPRENUREAL ACTIVITY. ASSUMING THAT THESE ISSUES ARE BEING DEALT WITH, WE CAN BEGIN TO ADDRESS THE MORE SPECIFIC QUESTION OF HOW TO BEST SPAWN TECHNOLOGY

VENTURES BASED UPON THE VERY EXTENSIVE RESEARCH AND DEVELOPMENT BEING ACCOMPLISHED WITH FEDERAL FUNDS.

REAUTHORIZATION OF STEVENSON-WYDLER ? - THE NEXT STEP:

AS WE TURN TO THE SPECIFIC ISSUE OF REAUTHORIZATION OF STEVENSON-WYDLER, WE ARE FACED WITH A SOMEWHAT UNIQUE SCENARIO. ON THE ONE HAND, THERE IS CONSIDERABLE EVIDENCE THAT THE GOALS ARTICULATED IN SECTION 3 OF THE ACT HAVE BEEN ACCOMPLISHED. INDEED, IT APPEARS IN SOME CASES THAT THE ACT HAS MADE A CONTRIBUTION FAR MORE IMPORTANT THAN EVEN ANY OF THE SPECIFIC PROGRAMS IT AUTHORIZED: IT BEGAN TO CHANGE THE BUREAUCRATIC MINDSET TOWARDS SUPPORTING, RATHER THAN FRUSTRATING TECHNOLOGY TRANSFER AND COMMERCIALIZATION INITIATIVES. JUST YESTERDAY AFTERNOON I MET WITH THE PRESIDENT OF NEW MEXICO'S TECHNET, A NON-PROFIT ORGANIZATION WORKING TO BUILD A COMPUTER NETWORK LINKING UNIVERSITIES, MAJOR FEDERAL LABORATORIES AT LOS ALAMOS AND SANDIA, MAJOR NSF FACILITIES SUCH AS THE VERY LARGE ARRAY, AND THE PRIVATE SECTOR. THIS EXCITING AND AMBITIOUS PROJECT IS BEING SUPPORTED BY THE DEPARTMENT OF ENERGY VIA GRANTS AND, MUCH MORE IMPORTANT, VIA EXPERTISE FROM THE DOE LABORATORIES LOCATED IN NEW MEXICO. ACCORDING TO TECHNET OFFICIALS, THE "BUREAUCRATIC NOD" FOR THE DOE COOPERATION WAS MADE MUCH EASIER BECAUSE OF THE "UMBRELLA" PROVIDED BY STEVENSON-WYDLER.

BEYOND THE SPECIFIC ACCOMPLISHMENTS, IT APPEARS THAT THE ISSUE OF FEDERAL TECHNOLOGY TRANSFER AND INNOVATION HAS FOUND CONSIDERABLE

SUPPORT AT THE STATE, LOCAL, AND PRIVATE SECTOR LEVELS. AS THE SECRETARY OF COMMERCE NOTED IN HIS REPORT TO THE CONGRESS ON THE IMPLEMENTATION OF THE ACT, THERE APPEARS TO HAVE BEEN A RESURGENCE OF ACTIVITY THAT HAS MULTIPLIED THE ACT'S INTENT MANY FOLD WITH THE HAPPY CONSEQUENCE THAT THE CONCEPT OF TECHNOLOGY INNOVATION AND TRANSFER SEEMS ONCE AGAIN IMBEDDED IN OUR SYSTEM. BY THESE STANDARD MEASURES ALONE, MANY OF US HAVE CONCLUDED THAT THE ACT HAS SUCCEEDED AND DOES NOT NEED TO BE REAUTHORIZED IN ITS PRESENT FORM. HOWEVER, THERE ARE SEVERAL QUESTIONS THAT REMAIN UNANSWERED:

IF THERE IS NO NEW ACT, WILL THE PROGRAMS THAT NOW SEEM TO LOOK TO STEVENSON-WYDLER FOR BACK-UP - SUCH AS TECHNET - BE UNABLE TO CONTINUE?

WHAT ABOUT THE MOST IMPORTANT TECHNOLOGY TRANSFER FUNCTION OF ALL, THAT OF PROMOTING EXCHANGES OF SCIENTIFIC AND TECHNICAL PERSONNEL BETWEEN FEDERAL AND PRIVATE SECTOR LABORATORIES, PARTICULARLY SMALLER BUSINESSES?

HOW CAN THE CONGRESS ENSURE THAT OPPORTUNITIES FOR SUCH EXCHANGES ARE BEING AGRESSIVELY PURSUED UNLESS SOME LEAD AGENCY, SUCH AS COMMERCE, IS ASKED TO MONITOR THIS PROGRAM FROM A CENTRAL VANTAGE POINT?

IS REAUTHORIZATION OF THE ACT REQUIRED TO FOSTER OR PERHAPS EVEN ALLOW FOR EXTENSIVE ACTIVITY IN THIS REGARD? IS A

CONTINUING PROGRAM OF STUDIES CONCERNING THE INNOVATION PROCESS STILL NECESSARY? IF SO, WILL THOSE STUDIES BE ACCOMPLISHED WITHOUT A NEW ACT?

ASSUMING THAT THE PROCESS THAT STEVENSON-WYDLER APPEARS TO HAVE HELPED FOSTER CONTINUES WITHOUT A NEW ACT, IS THERE SOME MONITORING AND PROGRAM EVALUATION MECHANISM THAT CAN RING THE WARNING BELL WHEN A NEW COURSE CORRECTION IS NEEDED?

BECAUSE THESE QUESTIONS REMAIN, THE MAJORITY OF THE NCST TASK FORCE ON TECHNOLOGICAL INNOVATION BELIEVE THAT THE ACT SHOULD BE REAUTHORIZED AFTER SOME "TUNING" TO REFLECT THE CHANGES THAT HAVE HAPPENED SINCE 1980.

SPECIFICALLY, THE TASK FORCE ASKED ME TO PRESENT THE FOLLOWING IDEAS FOR YOUR CONSIDERATION AS YOU EVALUATE THE MERITS OF REAUTHORIZATION:

1. TO ENSURE SMALL BUSINESS PARTICIPATION IN NSF INDUSTRY/UNIVERSITY CENTERS, FUTURE CENTERS MIGHT BE TARGETED TO INCLUDE SMALL HIGH TECHNOLOGY COMPANIES. THE CAVEAT TO THIS, OF COURSE, IS THAT THE EMPHASIS MUST BE ON COMPANIES THAT ARE ENGAGED IN A PRE-DISPOSED BUSINESS DIRECTION THAT SUBSTANTIALLY BENEFIT FROM THE COOPERATION (SUCH AS A BIO-TECHNOLOGY COMPANY), RATHER THAN COMPANIES

WHO VIEW THE FUNDING FOR SUCH A CENTER AS A MAJOR REVENUE ITEM.

2. WHILE "HARD" SCIENCE IS THE CORE OF HIGH TECHNOLOGY SUCCESS, THE EMERGENCE OF ARTIFICIAL INTELLIGENCE AND MEDICAL TECHNOLOGY AS CRUCIAL "NEXT GENERATION" TECHNOLOGY AREAS POINTS TO THE IMPORTANCE OF RESEARCH IN SOCIAL, BEHAVIORAL, AND PHYSIOLOGICAL SCIENCES. THIS IMPORTANCE SHOULD BE REFLECTED IN FUTURE LEGISLATION IN SOME WAY.

3. THE ISSUE OF PATENT RIGHTS AS WELL AS INCENTIVES TO FEDERALLY FUNDED RESEARCHES TO TRANSFER AND COMMERCIALIZE INVENTIONS WAS RAISED BY ALL MEMBERS OF THE TASK FORCE AS CRITICAL TO THE SUCCESS OF FEDERAL TECHNOLOGY TRANSFER AND INNOVATION. REFORM IN THIS AREA COULD GO A LONG WAY TOWARDS ACCOMPLISHING STEVENSON-WYDLER OBJECTIVES WITH VIRTUALLY NO ADDITIONAL FEDERAL EXPENDITURES.

4. THE MAJORITY OF NCST TASK FORCE ALSO RECOMMENDED THAT THE DEPARTMENT OF COMMERCE'S HAND BE STRENGTHENED BY ALLOWING THE SECRETARY TO DESIGNATE A MODEST FUND FOR RESEARCH, EDUCATION, AND DEVELOPMENT (FRED) WHICH WOULD BE USED TO PROVIDE SEED MONEY AND MATCHING GRANTS FOR PROJECTS IN SUPPORT OF FEDERAL TECHNOLOGY TRANSFER AND INNOVATION. THIS MONEY WOULD BE USED FOR STUDIES DESIGNATED BY THE SECRETARY AS WELL AS TO PROVIDE SPECIAL GRANTS TO FEDERAL LABORATORIES OR OTHER AGENCIES. THIS YEAR'S ACT SHOULD

REQUIRE THE SECRETARY TO STUDY THIS PROPOSAL AND TO REPORT TO THE CONGRESS ON HOW SUCH A PROGRAM SHOULD BE ADMINISTERED SO THAT IT COULD HELP LEAD THE PROCESS WITHOUT APPEAR TO SET "INDUSTRIAL POLICY" AND WITHOUT INTRODUCING NEW BUREAUCRACY INTO THE PROCESS OF GOVERNMENT - UNIVERSITY - INDUSTRY COOPERATION.

5. PRIOR TO ENACTING NEW LEGISLATION, A REVIEW SHOULD BE MADE OF THE STATUTORY INHIBITORS TO COOPERATION BETWEEN FEDERAL LABORATORIES, LOCAL GOVERNMENTS, AND THE PRIVATE SECTOR. BASED UPON THIS REVIEW, NEW LEGISLATION SHOULD BE SPECIFICALLY DESIGNED TO ALLOW BROAD FLEXIBILITY DIRECTLY TO THE LOCAL LABORATORY MANAGEMENT.

FINAL OBSERVATION AND SUMMARY

IN SUMMARY, MR. CHAIRMAN, WE OF NCST BELIEVE THAT THE ISSUE OF TECHNOLOGY TRANSFER AND INNOVATION IS FUNDAMENTAL TO AMERICA'S ECONOMIC FUTURE. WE HAVE TREMENDOUS ADVANTAGES IN THE WORLD MARKET PLACE - WE ONLY NEED TO USE THEM WISELY. THE TEMPTATION ALWAYS EXISTS TO COPY OTHERS, TO TRY TO DUPLICATE THEIR SUCCESS. BUT, WHILE WE MUST ALWAYS RESIST THE TEMPTATION TO SHUT OUT FOREIGN IDEAS, WE MUST ALSO NEVER FORGET THAT OUR FREE ENTERPRISE ENTREPRENUREAL SYSTEM HAS ALWAYS, EVEN DURING SLACK TIMES, DEMONSTRATED VITALITY NOT FOUND ELSEWHERE. THERE ARE NEVER ANY EASY ANSWERS, PARTICULARLY IN HARD

BUDGET TIMES. BUT ON BALANCE PERHAPS THE LACK OF DOLLARS FOR MAJOR NEW PROGRAMS CAN PROVIDE US WITH A UNIQUE OPPORTUNITY TO WORK TOGETHER TOWARDS NEW, INNOVATIVE APPROACHES THAT CAN CARRY US INTO FUTURE GENERATIONS. AS A FIRST STEP, WE SUGGEST THAT THE COMMITTEE WORK TO FOCUS ATTENTION FIRST ON THE AREAS WHERE WE ALREADY HAVE CONSIDERABLE CONSENSUS, ONLY WHEN WE HAVE UNIFIED TO DEAL WITH THESE "EASIER" ISSUES WILL WE BE ADEQUATELY PREPARED TO RESOLVE THE "HARDER" ONES. WE OF NCST LOOK FORWARD TO BEING AN ACTIVE PART OF THAT INNOVATIVE PROCESS.

SUMMARY OF KEY ASSUMPTIONS

1. THE FEDERAL GOVERNMENT ALREADY HAS A MAJOR TECHNOLOGY INNOVATION ROLE BY VIRTUE OF THE LARGE FEDERAL COMMITMENT TO BASIC RESEARCH AND SUPPORT OF "CORE" MISSIONS SUCH AS DEFENSE. REGARDLESS OF ANY NEW PROGRAMS OR INITIATIVES, THE FEDERAL GOVERNMENT ALREADY HAS A VERY MAJOR ROLE IN TECHNOLOGY INNOVATION. IN FACT, WHILE THE COMMITTEE IS AWARE OF THE SIGNIFICANCE OF THIS ALREADY ENTRENCHED FEDERAL ROLE, MANY OTHERS DO NOT REALIZE THAT THE U.S. INVESTMENT IN FEDERAL RESEARCH AND DEVELOPMENT DWARFS SIMILAR EXPENDITURES BY COUNTRIES SUCH AS JAPAN. THUS, THE ISSUE BEFORE THIS COMMITTEE TODAY IS NOT WHETHER THE FEDERAL GOVERNMENT SHOULD HAVE A ROLE, BUT, RATHER, HOW THE ROLE IT ALREADY HAS CAN BE PROPERLY MANAGED TO ENSURE MAXIMUM LEVERAGE OF SCARCE FEDERAL DOLLARS TO FUEL STRONG ECONOMIC GROWTH.

2. MAJOR NEW PROGRAM FUNDING IS UNLIKELY. WE RECOGNIZE THAT THE BUDGET SITUATION IS SUCH THAT MAJOR NEW FUNDING FOR SECOND GENERATION STEVENSON-WYDLER TYPE PROGRAMS IS UNLIKELY TO BE AVAILABLE. YET, WE HAVE FOUND WITHIN NCST A BROAD CONCENSUS THAT THE COMMERCIALIZATION OF TECHNOLOGY - PARTICULARLY THAT TECHNOLOGY DEVELOPED WITH FEDERAL FUNDS - MUST BE AFFORDED A HIGH PRIORITY IF THE U.S. IS TO CONTINUE ITS CURRENTLY INDUSTRIAL LEADERSHIP IN THE NEXT DECADE AND BEYOND.

3. ADDITIONAL BUREAUCRACY WILL HURT, NOT HELP INNOVATION AT THIS TIME. WE RECOGNIZE THAT IF A FEDERAL INITIATIVE IS TO INDEED

RESULT IN NEW TECHNOLOGY VENTURES, IT MUST BE SO STRUCTURED AS TO REMOVE IMPEDIMENTS THAT MAY NOW EXIST WITHOUT CREATING NEW IMPEDIMENTS IN THE PROCESS. ANY PROGRAMS OR INITIATIVES THAT ATTEMPT TO "INSTITUTIONALIZE" TECHNOLOGY TRANSFER AT A HIGH LEVEL RATHER THAN SIMPLY STREAMLINING THE MECHANISMS SO THAT IT CAN HAPPEN AT THE WORKING SCIENTIST LEVEL MUST BE CAREFULLY CONSTRUCTED IF THEY ARE TO SUCCEED. STEVENSON-WYDLER TOOK SOME INITIAL STEPS DESIGNED TO "UNTIE" THE HANDS OF AGENCIES AT THE LABORATORY LEVEL; THIS PROCESS SHOULD BE CONTINUED.

4. TECHNOLOGY TRANSFER HAPPENS WHEN TECHNOLOGY DEVELOPERS ARE JOINED FREELY WITH TECHNOLOGY USERS - IT DOES NOT HAPPEN AS A FUNCTION BETWEEN TWO ORGANIZATIONS. IN DETERMINING FUTURE POLICY, THE PROGRAMS AND ORGANIZATIONS ESTABLISHED BY STEVENSON-WYDLER SHOULD BE EVALUATED BY HOW EFFECTIVELY THEY HAVE FACILITATED THE JOINING OF RESEARCH SCIENTISTS WITH TECHNOLOGY USERS. WE BELIEVE THAT THIS IS THE SPIRIT BEHIND THE ACT AND HAVE TAKEN THIS INTO ACCOUNT IN SUGGESTING SOME FUTURE STEPS.

FBB/MK

This Testimony was prepared with the assistance of the NCST Task Force.

The information contained may not represent viewpoints of individual members or advisors. A list of Task Force members is available upon request.

NCST

NATIONAL COALITION FOR SCIENCE AND TECHNOLOGY

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Recommendations for Amending the Stevenson-Wydler Technology Innovation Act, P.L. 96-480

The following recommendations are based upon testimony previously delivered by NCST. Copies of the testimony are available upon request from the NCST office. New language is underlined in the text.

Section 3. PURPOSE

(2) promoting technology development through the establishment of centers for industrial technology and other forms of intersectorial cooperative research, development, and education;

Section 5. COMMERCE AND TECHNOLOGICAL INNOVATION

(c) DUTIES —

(5) propose and support evaluations, studies, and policy experiments, whenever possible in cooperation with other Federal agencies, to determine the effectiveness of measures currently in place or which have the potential of advancing United States technological innovation;

Section 6. CENTERS FOR INDUSTRIAL TECHNOLOGY

(a) (1) the participation of individuals from industry, universities, and federal and nonprofit laboratories in cooperative technological innovation activities;

(2) the development of the generic natural and social scientific and engineering research base, important for technological advance and innovative activity, in which individual firms have little incentive to invest or in which individual small firms lack sufficient resources to sustain longer-term, higher risk research in the absence of cooperative efforts, but which may have significant economic or strategic importance such as manufacturing technology;

(3) the life-long education and training of individuals in the technological innovation process and in substantive scientific engineering, and technical knowledge;

(4) the improvement of mechanisms for the dissemination of scientific, engineering, and technical information among universities, federal and nonprofit laboratories, and industry;

(5) the utilization of the capability and expertise, where appropriate, that exists in Federal laboratories; and

(6) the development of continued financial support from other private and public sources through, among other means, fees, licenses, and royalties.

(b) ACTIVITIES — The activities of the Centers shall include, but not be limited to —

(1) research supportive of technological and industrial innovation including cooperative industry-university-federal and nonprofit laboratory basic and applied research;

(2) assistance to individuals and small businesses in the generation, evaluation and development of technological ideas supportive of industrial innovation and new business ventures;

(3) technical assistance, human resources assistance, and exporting assistance, and/or other advisory services to industry, particularly small businesses; and

(4) curriculum development, training, and instruction in innovation, entrepreneurship, and industrial innovation, and in scientific, engineering, and technical topics.

Section 8. NATIONAL SCIENCE FOUNDATION

(a) Establishment and Provisions of Centers for Industrial Technology —

(b) Planning Grants for Centers — The National Science Foundation is authorized to make available nonrenewable planning grants to universities or nonprofit institutions for the purposes of developing the plan, as described under section 6(c)(3). Between proposals of approximately equal merit, preference shall be given to those proposals which are likely to maximize participation of small firms in the resulting center.

(c) ESTABLISHMENT AND PROVISIONS OF OTHER PROGRAMS STIMULATING INTER-SECTORIAL COOPERATION — The National Science Foundation shall support the development, testing, and evaluation of models for stimulating cooperation between recipients of grants, contracts, and cooperative agreements for research and development and companies interested in utilizing the results of federally-funded research for industrial innovation as well as of other models for maximizing the spin-off economic and other practical benefits of federally-funded research and development and shall actively disseminate successful models to other federal agencies and interested public and private organizations.

(d) TERMS AND CONDITIONS —

Section 9. ADMINISTRATIVE ARRANGEMENTS

(b) COOPERATION — It is the sense of Congress that departments and agencies, including the Federal laboratories, whose misssions are affected by, or could contribute to, the programs established under this Act, should:

(1) seek to facilitate, to the greatest extent practicable,

cooperation between recipients of grants, contracts, and cooperative agreements for research and development and companies interested in utilizing the results of federally-funded research for industrial innovation;

(2) develop, implement, and evaluate mechanisms for stimulating spin-off economic and other practical benefits in the conduct of research and development programs, and generally;

(3) within the limits of budgetary authorizations and appropriations, support and participate in activities or projects authorized by this Act.

Section 10. NATIONAL INDUSTRIAL TECHNOLOGY BOARD

(b) DUTIES --

(3) the preparation of the report required under section 5(d) and on-going oversight on the implementation of this Act;

(c) FUND FOR RESEARCH, EDUCATION, AND DEVELOPMENT -- Within one year from the date on which this law is enacted, the Board shall report to the President and to Congress on the feasibility and utility of establishing a Fund for Research, Education, and Development. If such a Fund is determined to be feasible and useful the Board shall recommend guidelines for activities by such a Fund, the amount of initial capitalization appropriate, and the means by which such a Fund should be capitalized. The Fund to be evaluated shall be --

(a) a trust fund established solely for the purpose of providing matching Federal funds or Federal seed funds for inter-sectorial projects in furtherance of any of the purposes of this Act or for any of the activities and projects authorized by this Act;

(b) permitted to make awards only after a competitive process in which evaluation criteria include the innovativeness of the inter-sectorial linkages or project being proposed, the commitment of non-Federal participants in the project as demonstrated by binding commitments of financial and in-kind contributions, the probability for substantial innovation and economic benefits, the probability of repayment of Federally provided funds through fees, royalties, profit sharing, or other means; and the adequacy of project evaluation and dissemination mechanisms; and

(c) supervised by Trustees consisting of the Board, a similarly constituted body, the Secretary, or an inter-agency committee.

Section 11. UTILIZATION OF FEDERAL TECHNOLOGY

[NCST does not have specific language at this time for amending this section. NCST is basically supportive of the approach embodied in H.R. 1572, the Federal Science and Technology Transfer Act of 1985. In addition to its informational

functions, we would authorize the FLC to sponsor cooperative projects funded by its members, should they desire to engage in projects beyond the scope or capabilities of a single laboratory. We disagree, however, with the mechanism for funding the Federal Laboratory Consortium (FLC). In place of a set-aside we suggest authorizing the transfer of funds set-aside for ORTAs, or other discretionary laboratory funds, to the FLC. The FLC should be authorized to expend funds through its own staff or through contracts, grants, and cooperative agreements subject only to the approval of a FLC Board of Directors. The FLC should be further authorized to locate FLC projects at any Federal laboratory subject only to the approval of the laboratory director.]

APPENDIX II

ADDITIONAL STATEMENTS SUBMITTED FOR THE RECORD

OFFICE OF THE PRESIDENT

CAMBRIDGE, MASSACHUSETTS 02139

June 28, 1985

The Honorable Doug Walgren
Chairman
Subcommittee on Science,
Research and Technology
Suite 2321 RHOB
Washington, D.C. 20515

Dear Representative Walgren:

I write in response to your letter of June 12 requesting that I provide, as an addendum to my testimony on the Stevenson-Wydler Act before the Subcommittee on Science, Research, and Technology, some observations on "MIT's experiences in transferring to industry and otherwise commercializing technological innovations deriving from sponsored research at the Lincoln Laboratory."

I am pleased to respond affirmatively to your request and, accordingly, have cited in a statement attached several examples of the transfer of significant technology to industry from programs sponsored by the Department of Defense at MIT's Lincoln Laboratory.

The examples cited have been chosen from different periods of time in the history of the Laboratory and are presented in brief summary form as I might have responded had you had time to ask the question at the hearing in which I participated.

Please do not hesitate to call on me at any time you think I might be of assistance to you or the staff in the work of the subcommittee.

Sincerely yours,

Paul E. Gray

Enclosure:

OFFICE OF THE PRESIDENT

CAMBRIDGE, MASSACHUSETTS 02139

Some Examples of Technology Transfer to Industry
From DOD Sponsored Programs at MIT Lincoln Laboratory

1. In the early 1950'S the first high-speed parallel digital computer was developed at the Lincoln Laboratory and the Digital Computer Laboratory of MIT. A very significant component of this computer was the invention and application of the first magnetic core memory. This computer development evolved into the design of the Semi-Automatic Ground Environment (SAGE) air defense computer system which employed upwards of 60,000 vacuum tubes and the first 64-kilobyte magnetic core memory. The IBM corporation was subsequently chosen to produce this computer for the Air Force and the Lincoln Laboratory-developed technology was transferred to IBM. With this technology, IBM provided the leadership for the development of the commercial computer market.

2. In the latter part of the 1950's the Lincoln Laboratory became involved in the development of small-sized computers for real-time control applications. One of the staff members, Kenneth Olsen, who was closely involved with this development, subsequently left the Laboratory to form the Digital Equipment Corporation (DEC). In a manner quite

analagous to the case of IBM, DEC provided the leadership in the commercialization of small-sized computers and has subsequently grown to become the world's second largest, after IBM, computer corporation.

3. In the early 1960's the laser diode was invented at the MIT Lincoln Laboratory and nearly simultaneously at the Bell Telephone Laboratories and IBM. The technology for the laser diode was subsequently transferred to a number of industries and has found wide-scale applications in many different types of commercial equipment. Perhaps the most significant application in recent times is that of the compact digital disc play-back system which is currently enjoying a rapid growth in the high-fidelity audio market.

4. In the early 1970's the Lincoln Laboratory developed a new type of semiconductor laser diode involving the elements indium, phosphorous, gallium and arsenide. This new type of laser diode is capable of providing very long lifetimes and operation at wavelengths corresponding to minimum attenuation in optical communications light fibers. The technology of this device has been transferred to industrial organizations for application in the important new field of high-capacity optical fiber communications systems.

Paul E. Gray

27 June 1985

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